Telephony.

THE AMERICAN TELEPHONE JOURNAL

Comprising Telephony, American Telephone Journal, Telephone Weekly, Telephone Magazine, Telephone Securities, The Telephone and Sound Waves

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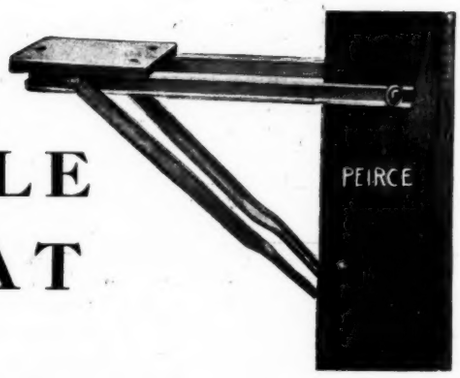

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TELEPHONY'S GREETING.

Ye men who gird the Earth with wire—
For all the wonders ye have wrought
To bring about the world's desire—
Take ye, this simple Christmas thought
"Good will to men!"

Co-Operation.

The value of co-operation is appreciated by all engaged in telephone work, but while the theory is preached, it is often not used in practice. As an illustration of the lack of co-operation may be cited the case of a horse and a mule pulling a canal boat. The horse was young and ambitious; the mule possessed all the traits usually attributed to the species. He believed with all his heart in looking before he leaped and then could think of all kinds of apparently good reasons for not leaping. Then again possibly he thought drawing the canal boat was not a leaping job, an idea which apparently did not occur to the horse.

The horse would strain in his harness and draw both the boat and mule after him, until he became tired and discouraged. He then would let the entire weight slip back upon the mule and lag behind for a while. After a brief period of hanging back, he would again bear his share of the load, and mule and horse would pull together for awhile, but not for long, as the mule's characteristic tendency to lag behind would again exhibit itself. The brief period when the work was divided equally, engendered a better feeling in the horse toward his companion, and when the load was again placed upon him, he would struggle along with it.

Gradually, however, the aggrieved feeling would manifest itself again in the horse and the performance would be again repeated. Sometimes by exceptional close attention on the part of the driver the ill-mated team would pull together for considerable distance.

The experience of the driver and his team is not unlike that of many telephone managers and his employes. Some of them are ambitious and willing to do more than their share, while others hang back and allow their work to be carried by the others, doing as little as possible until forced to do it by circumstances. Sometimes the manager can get his employes working in harmony and then everything runs smoothly. This condition is produced only by careful attention and the manager possibly has to neglect other duties in order to keep his team working to its best efficiency. When a manager is provided with a team or force of employes who do not pull together or harmonize, it is best for him to remove the disturbing element and replace them with employes who are willing to do their share of the work.

This is sometimes hard to do as a manager may be hampered in taking action by the higher officials of the company. They may have delegated authority to him something in the manner in which the general manager of an electrical manufacturing company did to his superintendent. The general manager found that he had more work in taking care of correspondence than he could handle with full justice to all.

After thinking the matter over he called his superintendent, and indicating a pile of papers on his desk said: "Macadam, I have an idea. It is one I have wanted to carry out for a long time, but these things, (pointing to the papers), are taking up more and more of my time. I have decided to turn the whole thing over to you. I know you will work it out in good shape."

Then he explained his plan and commissioned his superintendent to carry it out. While the general manager was discussing the job, Macadam began to plan his part. He saw how every detail could be performed. He saw there was a chance for the utilization of brains to carry out a real man's task.

The manager knew that Macadam was a good superinten-

dent and rarely disagreed with his recommendations for changes or improvements, although their methods of procedure were quite different. He was quick-witted, impulsive and imperative; Macadam was thoughtful, deliberate and capable.

As the superintendent turned to go, the manager called him back. "I want this thing done according to my ideas," he said, and then gave definite instructions which were to be followed.

This close to the interview dampened the ardor of the superintendent. His plans were just complete enough to interfere with the manager's, but not complete enough to form a working basis for the task as a whole. Neither of them realized it, yet the manager had jerked responsibility back upon himself, like a ball at the end of the string. The superintendent was not satisfied, his desire was to go back and argue it out with the manager, but interviews with the manager were generally monologues, as he invariably did all the talking himself.

When the finished work was completed, the superintendent was not proud of it, neither was the manager. A little co-operation would have produced better results.

The superintendent had been given a job to do, and would have produced satisfactory results if allowed to work out the problem himself unhampered in carrying out the ideas of the other man.

So in the telephone field, capable men are often given work to do and then the responsibility for it taken from them. A little co-operation would produce much better results.

Powers of State Commissions.

The United States Investor (New York), discussing editorially the matter of public utility commissions, declares that a point of great importance is the constitution of the board which has the enforcement of the law. The Investor continues:

"At the hands of a group of self-seeking or unintelligent commissioners, the provisions of the best public utilities regulation act that ever was passed can prove to have little virtue. The commission may either allow those provisions to count for very little while it caters to the goodwill of corporation officials, or, on the other hand, it can so abuse its power by too drastic a treatment of corporations as to impair efficiency. . . . The personnel of the commisison is everything."

So far from broad powers to enforce its mandates being the really essential thing to the successful conduct of a commission of this kind, the Investor declares that it is far more important that the commission shall have the broadest possible power to obtain information. The editor goes on:

"Suppose for a moment a railroad commission is quite without power to enforce its ruling, that it has power only to recommend to the corporation what needs to be done. How many corporations will dare to disregard such recommedations, provided the commission has the popular confidence and a reputation for knowing whereof it speaks? Only a very short-sighted corporation would flout the opinions and scorn the recommendations of such a board, for just as soon as the state legislature convened those recommendations would be rushed into law. Indeed, the corporation would be singularly fortunate if the angry legislature did not go even farther with coercive laws than the commission would have recommended. The people of the state would be likely to clamor for such excessive legislation because anything less would look like an insufficient punishment for so refractory a corporation.

If, on the other hand, the power to investigate was what the commission lacked, then, even though it have all the power in the world to enforce its decrees, its work may easily be unsatisfactory. It can do wrong both to corporation and the public when meaning to do absolutely right by both. It can order rates that will dry up the income of the corporation and thus prevent it giving proper service or it can authorize the corporation to charge rates which seem fair, but really are excessive."

The Right Time to Invest.

Nearly every one is at one time or another in his life importuned to invest some money in a business enterprise.

Sometimes he is to be allowed to come in on the "ground floor" as a special favor. When one offers to let you in on the ground floor it's a pretty good rule to take the elevator to the roof. It is an especially good rule when the enterpise is of an untried nature, no matter how sound the underlying principles of the business may be, as there is an experimental stage to be traveled in every new business and the road may be long and rocky before it reaches the dividend and surplus state.

If one can afford to lose his money, the possible gain may justify his risk, but if dependent upon the interest earning power of money for an income, it is better to let the business prove its ability to have the use of your money before risking it.

The right time has arrived to invest in the telephone business. The American public's most universal passion today is "get results" and there is no one factor half so important in getting results as the telephone. It is this efficiency of the telephone that has made its adoption irresistible by all classes. Its action being instantaneous, there is no possibility of its ever being supplanted, hence the permanency of the business is assured.

This is the condition as it exists today. The public is even now awakening to the fact that this valuable service which is being rendered in so satisfactory a manner must necessarily have back of it properly organized and well managed corporations in which investment may be made both profitably and with safety.

So the telephone as a business has arrived at manhood. It has always been a strong healthy lad and successfully traveled the rocky road of the experimental stage and now, with the consciousness of its strength and its character fully demonstrated, it is prepared to take its place among the matured business of this land, and one need not fear to place his funds in its keeping.

Solidity and advancement mark the conduct of nearly every telephone property locally owned and controlled. The state commissions are adding their safeguards continually, watching the administration of affairs and supervising, not only the service, but the issuance of securities, and the expenditure of the proceeds.

Surely, if ever a thing was sure, this is the time to invest in the telephone business!

Seattle Municipal Plant Cost Fixed at $3,000,000

Frank B. Hall, Engineer Employed by City of Seattle, Washington, Reports upon Establishment of Municipal Plant —Voters Approved Project Last April, Legislature Will Now Pass Enabling Act and Bond Issue Will be Voted upon Next Spring

Frank B. Hall, consulting and constructing engineer, of Newton Falls, Ohio, expert employed by the city of Seattle, Wash., to investigate and report upon the installation of a municipal telephone plant in that city, has just reported upon the cost of the establishment of such a system. Mr. Hall's cost estimates, based upon 20,000 stations installed, aggregate a total of $3,112,967; if increased to 30,000 stations, $3,699,180; if increased to 40,000 stations, $4,314,253. These figures provide for interest, working capital and supplies.

Frank B. Hall.

It is understood that an enabling act will be passed by the legislature some time next month, under which the city will be authorized to proceed with the installation of its plant. Following this it will be necessary for the citizens to vote upon a bond issue to supply the requisite funds. They have already voted, last April, in favor of the city constructing and operating its own plant to compete with the Pacific (Bell) Telephone and Telegraph Co., which has absorbed the Independent Telephone Co. The vote on the bond issue will take place next March.

The developments at Seattle are exciting wide interest throughout telephone circles because of their potential bearing upon future propositions of a similar nature. It is understood that the Bell company has already conceded that the enabling act will pass the legislature with but few dissenting votes, and that it is preparing to concentrate its opposition upon the bond election next spring.

In his report Mr. Hall states that his estimate covers "the cost of a complete telephone system, embracing all of the territory within the limits of the city of Seattle that has sufficient population to justify the expense of construction." He pointed out that there are some few isolated sections within the corporate limits of the city that are too sparsely settled to warrant the installation of telephones to which service could be given at reasonables rates.

He bases his computations upon the present exchange areas of the Bell company, Main, East, Queen Anne, Green Lake, University, Ballard, Georgetown, West Seattle and Beacon Hill. He advises, however, the addition of another exchange in this area which, he states, will reduce the installed apparatus in the present exchanges and shorten the wire mileage. These savings should, he states, more than cover the additional cost of real estate and building. Automatic or semi-automatic equipment is contemplated, the former being calculated for all main stations and extensions.

Mr. Hall divides his estimated 20,000 telephones into 7,000 business and 13,000 residence. He also allows for 250 private branch exchanges and for a toll board sufficient in size to care for the long-distance business which an exchange of this size should handle.

The average cost per main station is estimated at $138.44; per P. B. X. station, at $30.42; per extension, at $14.69, and per toll station installed, $151.71.

A. I. E. E. Directors Meet.

The board of directors of the American Institute of Electrical Engineers held its regular monthly meeting last week. Upon the approval of the sections committee, authority was granted for the organization of an Institute branch at the University of Washington, Seattle, Wash., bringing the number of university branches up to 46.

A discussion upon the general subject of technical committees of the Institute, with more particular reference to the appointment of additional committees for special fields of electrical engineering activity, resulted in the passage of a resolution authorizing the president to appoint a special committee to make a study of the entire subject of technical committees, some question having arisen as to the advisability of handling additional lines of work through new committees, or through sub-committees of the existing technical committees.

The president asked for the views of the board in regard to the desirability of the Institute taking up the subject of depreciation of electrical apparatus and machinery, and the allied subjects of amortization, going value, etc. There was considerable discussion on this question. It was considered of such importance that the president was authorized, in appointing the special committee to study the work of the technical committees, to refer to that committee the question of broadening the scope of the work of the Institute and the character and type of the papers to be presented.

The electric lighting committee reported upon the Illuminating Engineering Society's primer on "Light," the publication of which the Institute had been asked to promulgate as far as possible. It was decided to give publicity to the primer by a special article to appear in the January proceedings.

Eighty-nine associates and 89 members were transferred to the grades of member and fellow, respectively, in accordance with the provisions of the special section of the constitution.

Sun Company to Extend in Mississippi.

The Sun Telephone & Telegraph Co., with headquarters in Corinth, Miss., is planning the construction of a long distance line from Tupelo to Meridian, Miss., along the right of way of the M. & O. R. R., a distance of 120 miles. This will give the company connection with Meridian, Jackson, Hattiesburg and Yazoo City, in which cities the Mississippi Home Telephone Co. and allied concerns are operating.

With the completion of this line, the Sun company will have upwards of 600 miles of pole line in Mississippi, Alabama and Tennessee. These are all of heavy copper, and practically all of them are simplexed for telegraph use.

W. N. McAnge, Jr., general manager of the Sun Telephone & Telegraph Co., has recently gone over the route between Jackson and Dyersburg for the purpose of planning a line between those points and the establishment of a local exchange at Dyersburg.

Determination of the Size of Magnet Wire for Coil Windings

An Easy Method of Calculation for Winding to a Given Resistance or for the Greatest Ampere-Turns—A Method Which Has Been Used with Satisfactory Results—Its Application Made Clear by Illustrative Examples.

By Arthur Bessey Smith

The method which is here described has been worked out and used by the writer with satisfaction. The discussion is not intended to cover the entire theory or practice of coil winding, but to give just enough to make clear the working of the method. For instance, no corrections for temperature are provided. This is necessary when winding coils for maximum pull (ampere-turns), as the heating up of the wire will rob the coil of much of its power. Also, no corrections are made for rough winding. In the finer sizes of wire the variation in the diameter of the insulation will often offset all loss due to rough winding. In some cases it permits more wire than was calculated on the basis of smooth winding.

Electromagnets work under various conditions, but in practice most of them fall under a few classifications. These are as follows: parallel or full voltage and series in which one takes nearly the full voltage and the other must not weaken it appreciably.

The choice of cores, heads, or shape of spool will not be discussed, not being a part of the method of calculation presented. We will, therefore, assume that we have standard sizes of magnet spools as made by most manufacturers and that the problem is to select such a size of wire as will give a winding to secure any desired resilt.

Parallel coils, that is those designed to take the full battery voltage, may be wound for a certain current consumption, in which case the resistance becomes at once the fixed factor. If one does not care so much about economy of current, but desires great pulling ability, the winding will be for the greatest number of ampere-turns and the method of calculation will be different.

The calculation of a coil to be used in series with a magnet, which is nominally a full voltage one is limited by resistance. If the inserted coil has too great a resistance, it will reduce the current which the full voltage coil gets and thereby weaken it to the point of irregular and uncertain action. Hence, it is a matter of winding for resistance, which is the same as for the ordinary full voltage coil.

The sum of the matter is that there are usually two classes of calculations, one for resistance and the other for maximum ampere-turns.

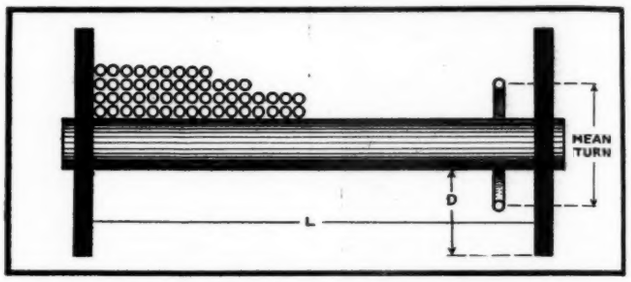
Winding for Resistance.

Suppose the spool that is shown in the illustration, represents the spool which it is desired to wind for a certain resistance. Let the following letters stand for the quantities placed after them:

E = applied voltage.
R = resistance of coil in ohms.
D = depth of winding space in inches.
T = length of average turn in inches.
r = resistance of wire, per inch.
I = current in amperes.
d = diameter of core in inches.
L = distance between heads in inches.
N = total turns.
m = diameter of wire over insulation in inches.

In the illustration are shown several layers partly wound. The turns are shown lying neatly side by side and on top of each other. This is called a "smooth winding" and is not always used. "Rough winding" is more common and will deviate somewhat from what has been calculated, especially for the larger sizes of wires. The small sizes, above No. 28 B. & S. gage, will wind about as many turns rough as smooth. All the calculations here made are based on the smooth winding.

The total resistance of a winding will be found by multiplying together the number of turns, the length of an



Assumed Conditions in Coil Winding.

average turn, and the resistance of the wire per inch. That is,

$$R = N T r \quad \ldots\ldots (1)$$

Notice also that the total turns, N, may be found by dividing the area of the winding space, A, by the square of the diameter of the wire, m. That is,

$$N = \frac{A}{m^2} \quad \ldots\ldots (2)$$

This value of N may now be substituted in equation 1, giving

$$R = \frac{A T r}{m^2} \quad \ldots\ldots (3)$$

This expresses the resistance of the coil in the simplest terms. Starting with the assumption that R is known, A and T can easily be calculated.

The area of the winding space equals the product of the depth of the winding space, D, and the distance between the heads, L.

$$A = L D \quad \ldots\ldots (4)$$

The average or mean turn lies half way between the core and the outside of the coil. Its diameter is the sum of the core diameter and the depth of the winding space. Hence, multiply their sum by 3.1416, which is called π.

$$T = \pi (D + d) \quad \ldots\ldots (5)$$

The purpose of equation 3 is the determination of the size of wire needed for a certain resistance and spool. Hence, it will be rearranged so as to have all the known quantities on one side and the unknown quantities on the other side. This gives

$$\frac{r}{m^2} = \frac{R}{T A} \quad \ldots\ldots (3a)$$

The fraction on the left side of this equation is composed of the two characteristics of the wire which will fix its size, its resistance per inch and its diameter over insulation. This does not always vary by mathematical laws, especially for enamel covered wire. Hence, it is better to construct a table giving the values of this fraction for all sizes of wire. These are given in Tables Nos. 1 and 2.

The following example shows the operation of the meth-

od. Suppose that a 1,000-ohm winding is desired on a spool, the core of which is half an inch in diameter when ready to wind, two inches between the heads, and the heads one and one-half inches in diameter. The depth of the winding space is, therefore, half an inch.

$D = 0.5$ in., $L = 2$ ins., $R = 1{,}000$ ohms.

To find T, use equation 5.

$T = 3.1416 \times (.5 + .5) = 3.1416 \times 1.0 = 3.1416$ inches.

Calculate A by use of equation 4.

$A = 2 \times .5 = 1.0$ square inch.

Then $$\frac{r}{m^2} = \frac{1000}{3.1416 \times 1.0} = 318$$

Now, if one wants to use double silk magnet wire, look in that table in the second column for the nearest number to 318. It lies between 284 for No. 35 wire and 408 for No. 36 wire. The smaller wire must be taken so No. 36 is selected.

It is interesting to notice that the properties of the coil will differ greatly with the kind of insulation chosen. This is because of the varying thickness of the insulation. The writer has calculated the factor $\frac{r}{m^2}$, the number of turns, and the resistance which would result from winding the spool full of each wire chosen from the different insulations, according to the above formula and the tables.

The results of these calculations have been tabulated and are given in Table No. 3.

This table reveals at a glance the greater space economy of enamel covered wire over other insulations. If its other qualities were equally as desirable but little other wire would be used.

Size of wire B & S	Factor	Turns N	Resistance R
37 S. cotton	406	9430	1290
39 D. cotton	367	5330	1160
35 S. Silk	437	16000	1380
36 D. silk	408	11800	1280
34 enamel	456	21000	1430

Table No. 3. Coil Winding Data for Different Kinds of Wire.

Winding for Maximum Ampere-Turns.

Next take the case in which the greatest possible magnetization is desired of the spool given, supplying the coil with current at a fixed voltage. The coil space will be wound full

Single Cotton Covered Copper Magnet Wire.					Double Cotton Covered Copper Magnet Wire.				
Size B. & S.	$\frac{r}{m^2}$	r ohms. in.	m diam., ins.	m^2	Size B. & S.	$\frac{r}{m^2}$	r ohms in.	m diam., ins.	m^2
20	.590	.000847	.03786	.001436	20	.477	.000847	.04216	.001778
21	.904	.001068	.03437	.001184	21	.717	.001068	.03866	.001493
22	1.38	.001346	.03125	.000978	22	1.065	.001346	.03555	.001264
23	2.08	.00169	.02847	.000811	23	1.58	.00169	.03277	.001072
24	3.16	.00214	.026	.000676	24	2.33	.00214	.03030	.0009180
25	4.75	.00269	.0238	.0005665	25	3.41	.00269	.0281	.0007896
26	7.13	.00339	.0218	.0004753	26	4.96	.00339	.02614	.0006834
27	10.6	.00428	.0201	.0004040	27	7.19	.00428	.02440	.0005954
28	15.7	.00540	.01854	.0003435	28	10.3	.00540	.02284	.0005219
29	23.2	.00681	.01716	.0002938	29	14.8	.00681	.02146	.0004604
30	34.0	.00858	.0159	.0002528	30	21.0	.00858	.02022	.0004090
31	49.1	.01080	.01483	.0002200	31	29.5	.01080	.01913	.0003660
32	71.1	.01365	.01385	.0001919	32	41.4	.01365	.01815	.0003295
33	102	.01722	.01298	.000169	33	57.7	.01722	.01728	.0002985
34	146	.02171	.0122	.0001489	34	75.6	.02171	.01656	.0002743
35	207	.02737	.01151	.0001325	35	110	.02737	.01581	.000250
36	290	.03452	.0109	.0001168	36	149	.03452	.0152	.000231
37	406	.04350	.01035	.0001071	37	203	.04350	.01465	.0002148
38	564	.05487	.009863	.0000973	38	273	.05487	.01416	.0002009
39	778	.06922	.009431	.0000889	39	367	.06922	.01373	.0001885
40	1066	.08720	.009044	.0000818	40	490	.08720	.01334	.0001780
Single Silk Covered Copper Magnet Wire.					Double Silk Covered Copper Magnet Wire.				
20	.722	.000847	.03426	.001174	20	.648	.000847	.03616	.001307
21	1.13	.001068	.03076	.0009462	21	1.00	.001068	.03266	.001069
22	1.76	.001346	.02765	.0007645	22	1.54	.001346	.02955	.0008734
23	2.73	.00169	.02487	.0006189	23	2.36	.00169	.02677	.0007165
24	4.27	.00214	.02240	.0005017	24	3.62	.00214	.02430	.0005904
25	6.59	.00269	.0202	.0004081	25	5.51	.00269	02210	.0004884
26	10.2	.00339	.01824	.0003328	26	8.36	00339	.02014	.0004057
27	15.7	.00428	.01650	.0002722	27	12.6	.00428	.01840	.0003385
28	24.2	.00540	.01494	.0002234	28	19.1	.00540	.01684	.0002835
29	37.0	.00681	.01356	.0001838	29	28.5	.00681	.01546	.0002390
30	56.5	.00858	.01232	.0001518	30	42.3	.00858	.01425	.0002030
31	85.6	.01080	.01123	.0001261	31	62.7	.01080	.01312	.0001722
32	130	.01365	.01025	.0001050	32	92.4	.01365	.01215	.0001476
33	196	.01722	.00938	.00008798	33	135.0	.01722	.01129	.0001275
34	300	.02171	.008504	.00007232	34	197	.02171	.01050	.0001103
35	437	.02737	.007914	.00006263	35	284	.02737	.00981	.00009625
36	647	.03452	.007300	.00005329	36	408	.03452	.0092	.00008464
37	954	.04350	.006753	.00004560	37	581	.0435	.00865	.00007482
38	1363	.05487	.006265	.00004025	38	767	.05487	.00846	.00007158
39	2035	.06922	.005831	.00003401	39	1160	.06922	.00773	.00005976
40	3046	.08720	.005350	.00002863	40	1620	.08720	.00734	.00005388

Table No. 1. Values of Coil Winding, Size Determining, Fraction for Cotton and Silk Covered Magnet Wire.

of whatever wire that it is found will give the strongest pull. The calculations will be as follows:

Let $M = NI$ = ampere-turns. .....(6)

But from Ohm's law it is known that $I = \frac{E}{R}$ ..(7)

But $R = rTN$ and $N = \frac{A}{m^2}$

so that if these values are substituted in equation 7

$$I = \frac{Em^2}{rTA} \quad \text{.....(8)}$$

Now, substituting this value of the current and of total turns in equation 6, $M = NI = \frac{AEm^2}{m^2rTA} = \frac{E}{rT}$ .....(9)

This means that the ampere-turns equal the voltage divided by the product of the resistance of the wire per inch and the length of an average turn.

The meaning of formula 9 is that the pull of the magnet may be varied by changing the resistance per inch of the wire, that is, by using larger or smaller wire. It is independent of the number of turns, provided the spool is wound full so that the length of a mean turn will be the same as has been calculated. Theoretically the larger the wire, the greater the ampere-turns and the stronger the magnet. There is no maximum.

There is, however, a practical limit due to the heat developed in the winding. The formula for heat is developed as follows: The power expended in the coil in watts, is given by

$$W = I^2R \quad \text{.....(10)}$$

From equation 3 $R = \frac{ATr}{m^2}$

and by Ohm's law, $I = \frac{E}{R} = \frac{Em^2}{ATr}$ .....(11)

Putting these values of resistance and current in equation 10 gives

$$W = \frac{E^2m^2}{ATr} \quad (12)$$

Arrange this equation to show the value of those quantities which fix the size of wire, thus

$$\frac{r}{m^2} = \frac{E^2}{WTA} \quad (13)$$

Hence, in order to wind a magnet for the maximum amperage-turns, first fix the greatest amount of power which it is desirable to expend in the coil, and then use formula 13 to find the size of wire which will give it.

Suppose that it is desired to wind the spool described for maximum pull and that 20 watts is the greatest power which can be safely used. The numbers to be inserted into formula 13 are: $E = 48$ volts, $W = 20$, $T = 3.1416$, $A = 1$ square inch.

Then $\frac{r}{m^2} = \frac{48 \times 48}{20 \times 3.1416 \times 1} = 36.7$

If double cotton covered wire is used the number 36.7 falls between Nos. 31 and 32, so that No. 32 will be used. Calculating the power consumption by means of formula 12, 17.7 watts is obtained, which is sufficiently close for ordinary work.

It is of value to notice the performance of different insulations, choosing the size of wire according to the above determined constant, 36.7, and winding the spool full. Table No. 4 has been prepared by this method and is worthy of careful study.

Notice, first, that the wire which most closely fulfills the power requirement, 20 watts, is that whose constant, $\frac{r}{m^2}$, is most nearly equal to the value desired. This is the single silk No. 29, whose constant is 37.0 and whose power loss for the full spool is 19.8 watts.

The wire which gives the greatest number of ampere-turns also agrees most closely in its constant with that calculated. The single silk No. 29 gives 2240 ampere-turns, while its nearest competitor, No. 29 enamel wire, gives only 2,190 ampere-turns. This is in spite of the fact that the enamel wire gives a greater number of turns (6,890) than the single silk (5,440). The reason lies in the greater resistance of the enamel wire winding, which is 151 ohms as against only 116 ohms for the single silk. The latter allows enough more current to flow to make up for the lack of turns.

ENAMELED COPPER MAGNET WIRE.

Size B & S.	r/m^2	r ohms, in.	m diam., ins.	m^2
22	1.91	.001346	02644	.0006991
23	3.01	.00169	.02367	.0005603
24	4.80	.00214	.02110	.0004452
25	7.53	.00269	.01890	.0003572
26	11.8	.00339	.01694	.0002870
27	19.0	.00428	.01500	.0002250
28	29.9	.00540	.01344	.0001806
29	48.0	.00681	.01205	.0001452
30	73.3	.00858	.01082	.0001171
31	117	.01080	.00962	.00009254
32	182	.01365	.00865	.00007482
33	284	.01722	.00778	.00006053
34	456	.02171	.00690	.00004761
35	710	.02737	.00621	.00003856
36	1140	.03452	.00550	.00003025
37	1780	.04350	.00495	.00002450
38	2890	.05487	.00436	.00001901
39	4480	.06922	.00393	.00001544
40	6960	.08720	.00354	.00001253

Table No. 2. Size Determining Fractions for Enameled Wire.

Wire	NI/m^2 ampere turns	W watts	N turns	I ampere	R ohms
Desired	36.7	....	20.0	....	.....	...
S. Cotton No. 31....	49.1	1410	15.0	4540	0.311	154
D. Cotton No. 32....	41.4	1120	17.7	3040	0.369	130
S. Silk No. 29.....	37.0	2240	19.8	5440	0.412	116
D. Silk No. 30.....	42.3	1780	17.3	4930	0.361	133
Enamel No. 29.....	48.0	2190	15.3	6890	0.318	151

Table No. 4. Data for Winding for Maximum Ampere-Turns.

Exchange Becomes Jail.

The breakfast bill of fare Friday at "Hotel Quarantine," in Cleveland, Ohio, was this: Hamburger steak, German fried potatoes, coffee and cakes, bread and butter, oranges. "Hotel Quarantine," says the Cleveland News, is the Lake exchange of the Cuyahoga Telephone Co., at Rocky River, which was shut up tighter'n beeswax Thursday following the discovery that Miss Lillian Stampsli, chief operator, had contracted smallpox.

Five operators and two men compose the quarantined force. They are Miss Stampsli; Roy Martin, town marshal and manager of the exchange; Mrs. Ida Coulter, his sister; Miss Olga Szlay, Essie Wood and Dalla Zuske, and Earl Martin, repair man and Roy's brother.

Five other night operators will have to be vaccinated and will be watched carefully for several days. The homes of the different marooned girls are in a state of semi-quarantine.

When General Manager Charles Y. McVey heard of the operators' plight he had five beds sent out for the captives.

Miss Stampsli is not inclined to regard her illness as serious. "I'm not in the least bit frightened," she said.

"It's lots of fun," declared Miss Szlay. "Miss Stampsli is not ill, and having our meals here is fun."

The "Going Value" of a Public Utility Corporation

Discussion of Elements Entering Into an Important Factor in Regulation of Rates of Public Service Companies by State Commissions—Paper Read Before Western Society of Engineers and Published in Proceedings—Second Installment

By Frank F. Fowle

The Methods of Determining Going Value.

Numerous methods have been proposed for determining going value, some of them based on apparent merit and worked out with much ingenuity and ability, while others seemingly have been offered in the effort to uphold inflated values which could not otherwise be sustained. These proposals have been pretty well sifted by the public service commissions in so far as they apply, of course, to public utilities. Regardless of the kind of business to which they appiy, the principal methods may be set down as follows:

1. Capitalizing the net earnings.
2. Finding the cost of reproducing the net earnings.
3. Capitalizing the early losses.
4. Capitalizing the cost of securing business.
5. Over-capitalization of consolidated companies.
6. Miscellaneous.

All of these methods but the first have been proposed mainly in reference to public utilities, where the problem of going value has raised so much discussion. Some of the difficulties surrounding the subject are probably due to the ingenious arguments put forward by those who have sought to maintain value or earnings which were threatened with reduction under the cost of service theory. Perhaps the sanest point of view can be maintained by discussing first the natural method of finding the going value in a private business, from the standpoint of the owner or investor. This is the first method enumerated above.

The Capitalized Net Earnings Method.

This method applies to all kinds of private business, and in one sense it applies to public utilities also, but under the cost of service theory it excludes any going value which can be capitalized for the purpose of earning a return. In the case of a private business, going value is the value in excess of the tangible investment, created by capitalizing the whole net earnings, after meeting depreciation, at the rate of interest which is current for investments of like character, location, and risk.

Taking a concrete example, suppose that the tangible investment is $100,000, and that the net earnings are $24,000 per annum; suppose further that the expected rate of return is 12 per cent. The net earnings capitalized at this rate amount to $200,000, which gives a going value of $100,000 or 100 per cent. in excess of the tangible investment or property value.

This is the point of view in regard to the going value which a prospective investor in this business would presumably take. Of course, he would consider other questions besides the rate of return and the risk of impaired earnings; he would consider whether the investment is liquid, also the character and ability of the management and the men in control or associate investors, the title to the property, the past record of earnings, possible or active competition, patent litigation, the market for raw materials and labor, and kindred matters. The example considered above is obviously one of more than ordinary risk, which would be most likely to attract investors with experience which would fit them to assume the management or intelligently direct it.

This is the common-sense definition of going value in general business; it rests absolutely on earnings in excess of the expected or usual return on the tangible property. Where such a return does not exist there can be no going value in the sense here defined, and if the net earnings do not equal the expected rate of return, the going value will be negative; that is to say, the investment value will be less than the cost of the tangible property. Value is here established and measured entirely by net earnings, without regard to cost of the tangible property.

The Cost of Service Method.

The cost of service theory measures value by actual cost or investment in the tangible property, as being the lowest value which is equitable. The rate of return which is regarded as reasonable depends upon local circumstances, but in the main it covers both the ordinary interest rate on secure investments and a margin of speculative profit; this is necessary to attract capital and stimulate development. The total return generally allowed is 7 per cent. to 8 per cent. This makes it possible, with certain forms of financing, to show a margin of going value.

Under the rule of conservative banking that a property should not be bonded beyond the point where the interest exceeds one-half of the net earnings, the stock can be made to show more than the rate of return allowed on the whole property. Consider, for example, a property which cost $100,000, and which is allowed to earn 8 per cent. or $8,000 per annum. Assume that the bonds bear 6 per cent. interest, but not more than $4,000 gross interest charges per annum; then it will appear that the stock has earnings as follows:

	Value.	Interest Rate.	Net Earnings.
Total	$100,000	8%	$8,000
Bonds	66,700	6%	4,000
Stock	$ 33,300	12%	$4,000

The bond issue amounts to $66,700 and the stock issue to $33,300. The stock earns $4,000 per annum or 12 per cent. and on an 8 per cent. basis each share of stock would be worth $150 on a par value of $100. This would apparently produce a total going value, based on earnings, of $16,700; but obviously this would not be a value which could be added to the cost of the tangible property for rate making purposes. It is also essential to recognize that the bonds represent a first lien on the property and the net earnings; the preferred stock would come next and the common stock last. Thus the stock represents to some extent a speculative margin where the financing is done in this way. It would be the first part of the investment to feel the effect of a falling off in net earnings and thus the market value of the stock might fluctuate, making it unwise to capitalize the going value which apparently exists.

It is also well to recognize that while such an element of going value is supported by the net earnings on the stock, it has no physical value behind it and would be wiped out if the property were taken under condemnation proceedings. Thus the trading in such shares at prices above par would always involve a risk which the purchaser must assume.

The clear intent of the cost of service theory of rates is to limit values to the fair cost of all the tangible property. Thus there can be no going value, under this theory, which is supported by net earnings in excess of a reasonable rate of return on the property. If this were not the

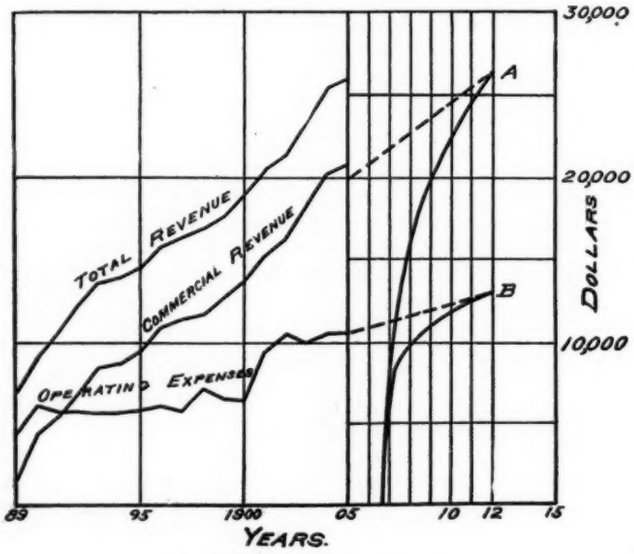


Fig. 1. Plot of the Revenue.

case, the modern theory of regulation would fail to accomplish its purpose, and rates founded on the value of service theory, under former conditions, would continue to be impregnable.

The Reproduction of Net Earnings Method.

This method of appraising going value evolved some 12 years ago by civil engineers who were engaged in the valuation of water works. It has been very well described in a paper by John W. Alvord, on "Notes on Going Value and Methods for Its Computation," read before the American Water Works Association, at Milwaukee, 1909. The method is a general one, which may be applied to any utility provided the proper data are available. The cost or reproduction theory is very generally applied in determining the value of any physical property, but the present method of appraising going value extends the application of this theory and aims to determine the cost of reproducing the net earnings of the business. The Railroad Commission, of Wisconsin, in discussing the subject of going value in the Beloit case, quotes as follows from a report by Benezette Williams:*

"All utilities that are distinctly public ones have a continuing existence. The acquired revenue of such utilities is also continuing and is the basis of an element of value which augments the physical value. The element is the 'going value,' of the potential business value, the amount of which must be determined by the net income which a plant in operation will have in excess of what a substitute plant of like character, the construction of which is begun at the time of valuation, can produce, the annual excess earnings being reduced to present worth."

This briefly defines the method, which seems rather simple in its conception, but is surrounded with certain difficulties in its application. Certain fundamental data are necessary, including the complete financial history of the business from commencement to date, the proportions of revenue derived from public and commercial service, the size and rate of growth of the community served and the general character of the demand.

*7 W. R. C. R. 276.

The general supposition is that on the date of appraisal the existing plant and all of its business will be suddenly wiped out, and then, under the reproduction theory, work will be commenced at once to reproduce the physical property just as it was before, and the business which the old plant had will be acquired by the new one as fast as possible. The community served, however, is not presumed to change in any way from its present size and character, except through natural growth. Obviously some time will elapse before the revenue of the new plant will catch up with the probable revenues of the old one, and thus the act of reproducing the going business will entail some loss during the first few years. This method aims to determine the probable extent of that loss and then reduce the total amount, by discounting it at compound interest, to its present value and calls that the present worth of the going value.

The general procedure is to plot the total revenue, the commercial revenue, and the operating expenses from the inception of the busines to date, or else far enough into the past to establish a safe guide for the future. The revenues from public service, such as fire hydrants or street lighting, are not taken into consideration, because it is assumed that these can be reproduced as soon as the new plant is ready for operation, thus entailing little or no loss. The commercial revenues and the operating expenses of the present plant are projected into the future, and by means of curves showing the established revenues and the expenses of the new plant, the date is found on which the revenues of the two plants will become equal.

An example of this is shown in Fig. 1, which is reproduced from Plate I, of Mr. Alvord's paper. In addition to the curves shown, the population is often plotted, to aid in estimating the future revenues. The assumed date of valuation of this plant is 1905 and it is estimated that the two plants will have equal revenues after 1912, or a lapse of seven years. However, a period of one and one-half years is assumed as the construction period of the new plant, during which it will have no revenues. The point A shows where the commercial revenues of the new plant catch up with those of the old ones, and the point B shows where the expenses of the two plants become equal.

This set of curves does not reveal the theoretical going value, but provides a means for calculating it. This value must be determined for each year until the revenue curves meet, then reduced to present worth and summed up, giving the

	Present Plant.	New Plant					
Year	Commercial Revenue	Commercial Revenue	Difference in Operating Expenses.	Total Credits	Annual Going Value	Factor	Present Worth of Going Value.
1907	$21800	$8500	$3500	$12000	$9800	.952	$9340
1908	22720	16000	1500	17500	5220	.907	4740
1909	23640	19500	800	20300	3340	.864	2870
1910	24560	22500	400	22900	1660	.823	1380
1911	25480	24800		24800	680	.784	530
1912	26400	26400		26400	0		0
Date of Valuation, 1905.					Total		$18860

Fig. 2. Computation of Going Value (See Fig. 1).

total present going value. The calculations for the example shown in Fig. 1 are given in Fig. 2.

The estimated present worth of the going value is $18,860 as shown by the footing of the last column in Fig. 2. This method has been applied in numerous water works cases and also in some gas and electric cases, as showing

the value of the going business over and above the physical values found by the cost of reproduction theory. A summary is given in Mr. Alvord's paper of twenty cases in which this method has been applied. It is interesting to note that the ratio of going value to physical value ranges from 9.6 per cent. to 47.0 per cent., showing that there is no tangible relation between the two under this theory. Likewise there is no relation between going value and population, or the number of service connections, or the gross revenue. The period of recovery in these cases varied from 5½ to 11 years.

(To be continued.)

Some Industrial Incidents

Caveat Emptor—Stockholders—Stock, Etc.

By J. C. Kelsey

When we were boys and indulged in the so-called Yankee habit of trading, the one who got the best of the trade always said "Red leather, trade forever." That remark sealed the trade, and the one with the advantage washed his hands of the whole affair and let the victim soothe himself the best he could.

This idea comes down from ages. In Shylock's day the theory of trade was *caveat emptor*—"let the buyer beware." It was a plain case of washing one's hands of the deal and seeking new victims.

If you ever investigated a business wreck, you found that *caveat emptor* was the fatal disease with which the management of the ruin voluntarily inoculated themselves.

The principal exponent of *caveat emptor* is the real estate dealer. "Let the buyer beware," sure enough!

It is not considered a sin to sell even a dependent widow a bit of swamp land. All is fair in real estate.

Caveat emptor is the principle of the automobile trade. I doubt if in all industrial history you will find such utter business depravity as you can find in the Chicago automobile row.

I am told that gears are filled with sawdust and graphite to make them quiet. And, if you buy, it is "let the buyer beware," with a vengeance!

I imagine that the principle of *caveat emptor* began when trading ships visited a place but once. But in these days of easy communication no firm can get very far away from its customers. Hence, society has compelled a new idea of not only finding a market, but compelling the dealer to act as a trustee for the protection of the customer.

Those who have been in Marshall Field's store in Chicago can realize that its annual trade of over $100,000,000 is based upon the modern idea. Nowhere in the charter of this great company are the words, *"caveat emptor."*

If you do not like your purchases, you may return them and get your money back.

Look what this principle teaches a great house—to inspect its own quality closely and make nothing of questionable character.

I just read the very able address of the president of the Investment Bankers' Association. In this address he pleads with the bond dealers not to wash their hands of a bond sale, but to unite to sustain the market as well as to make offerings.

He says, "Why should an investor buy of us a second time if he finds that we will not trade in what we have sold him?"

You see, the old principle is to sell a man a bunch of bonds and let him beware—*caveat emptor!*

But a wise president, who has seen the bond dealers falling in disrepute and the business suffering has laid his hands upon a very decided sore.

The spirit of fair trading must be extended to every public service corporation, too. The public gives a franchise in exchange for the best service a company can render.

No corporation can expect to survive disaster without a willingness to trade fair. It is permanently located. It has not only to develop its market, but must be a trustee for the protection of its purchaser.

No concern which makes a specialty of good service has great trouble with its rate schedule.

The bond dealers not only were lectured on a fair trading plan, but put in a great deal of time on the "blue sky" law of Kansas. This "blue sky" matter is a relic of *caveat emptor*, too.

Something has to be done to protect the unsophisticated person from buying a worthless security. A widow, left with $2,000 or $5,000, is easily tempted to buy something which will give her a supposedly high income.

The very moment you die your widow will be literally bombarded with "blue sky" literature. So don't ignore this very essential thing, and save the widow from scrubbing floors or taking in washing.

The world is never very kind to a woman left upon charity. People take their spite out on the wrong person. They really mean you, but you are too far below the level of the soil to notice it.

Don't you see? Everything is working to a leveling process, that of mutuality. It is the law of survival.

As long as the world lasts people will have to entrust their money into others' hands. Just study the following list of stockholders—an army of people utterly dependent upon the motives of others:

	Stockholders.
United States Steel	105,000
Pennsylvania Railroad	75,000
American Telephone	50,000
Canadian Pacific	38,000
Santa Fe Railroad	30,000
New York Central	20,000
Swift & Co.	19,000
Southern Pacific R. R.	15,000
St. Paul Railroad	15,000
Western Union	12,300
Pullman Co.	12,000
Westinghouse Co.	7,300

And so on down the list. In fact, there are 2,000,000 people holding stocks in railroad and industrial enterprises. It is safe to say there are nearly as many bondholders.

I have often been asked the difference between preferred stock and bonds from the company's standpoint.

A company with $1,000,000 of preferred stock has a better credit and borrowing power than a company with $1,000,000

bonds, merely because money can be borrowed which can come ahead of the preferred stock.

In trying times failure to pay a dividend on preferred stock does not involve foreclosure.

The effect upon stocks by the recent Democratic victory has been very, very little marked.

We all know that concerns which depend upon unusual bounty or graft should be put on a merit basis or chloroformed out of existence. That the owners of such stocks are self-conscious is shown in the following table:

	Oct. 22.	Now.	Loss.
American Beet Sugar	$ 71	$ 52	$19
Union Bag and Paper	59	47	12
American Woolen	89	79	10
Bethlehem Steel	48	39	9
American Sugar	126	118	8
International Paper	59	52	7

Every one of these concerns has deliberately tried to kill competition, have raised prices arbitrarily, enjoyed grafts and privileges and cheated the government scales.

Look at the prices of the stock even at the high mark. It surely looks as if monopoly and unusual privilege are not enough to keep stock at par.

Bethlehem Steel has never paid a dividend, yet its controlling mind, Charles Schwab, is able to keep house on Riverside Drive.

This country surely should call for a show-down. A little concern in Cincinnati makes a very humble article. It does not depend upon Schedule "K," nor does it cry out in its sleep. It is just plain Ivory soap.

It sold last month at $459 a share, nearly $100 higher than a year ago. It has $14,250,000 of common stock and pays 16 per cent. dividends—also an extra 4 per cent. this year.

Why is it that these unostentatious industries, attending to their own business, asking only moderate protection, can pay 16 per cent. when some over-protected concern pays nothing?

Making soap seems to have steam laundries easily beaten. Even a "coffee-and-sinker" business seems to be outclassed.

It sounds big to go to Japan and bid on a big battleship and to build a few. But it certainly pays a stockholder better to invest in plain old soap, which every household uses every Monday morning and Saturday night

It is surely a lesson for all of us—to keep our heads out of the stars and watch the ground a little more closely.

There are lots of other popular misconceptions. One has regard to the common every-day bank check. A check is not money. It is merely an order to pay money. For instance, you buy goods from a Chicago firm. When they come, you draw your check for the amount of the bill and rest content with paying the bill.

The dealer banks the check and marks the bill "paid." He, too, is content. So far no money has been paid by or to any one. It looks like high finance.

Then the bank begins to get busy. In a week the bank collects its money, less some exchange.

There has been a great deal of fuss about exchange charges on out-of-Chicago checks. New York charges exchange on Chicago checks. Chicago gets even by charging every one smaller than herself. Simply a game of "passing it along."

That innocent little game of "passing it along" accounts for the increasing cost of living. Last week I heard the barber complaining about the inferior quality of restaurant coffee and the small size of sandwiches.

This week the price of a hair-cut went up from 25 to 35 cents. The barber was merely passing it along.

The people who seem to have the real trouble about passing it along are the telephone companies. I don't know why this particular industry should be denied the right to do what every one else is doing.

We all know that both manufacturer and operator have suffered from the extreme lowness of telephone rates. No telephone rate should be under $18 a year, whether farm, residence or business.

A clipping just placed before me shows that the business men of Lebanon, Ind., have objected to a raise in rates at that point.

There is no doubt in the world that these rates should be higher. But there is one weak link in the telephone company's chain. It did not live up to the spirit of its franchise when it bought a second-hand switchboard. That was a doubtful improvement and deserves some criticism.

But it strikes me queerly that Indiana has neglected to have a state corporation commission. This would settle the Lebanon contention in a few days.

The public utilities commission is a necessary thing. Ohio expects to have two bodies, one to deal exclusively with railways and the other to take all the remaining utilities.

It seems incredible that two great states, such as Illinois and Indiana, should fall so far behind the other states.

A public utility commission is a sort of a "blue sky" law in itself. The "blue sky" law supervises the securities of a project before it becomes started. The commission controls the securities after the project gets under way. No commission will allow the controlling interest of a company to rob the stockholders by fictitious maintenance charges, nor will it allow a company to sell stock to keep up its plant until the promoters can unload.

It is plain that the day of regulation and control is at hand. We will never get along without combination of capital or corporations, and never will be without the need of proper supervision.

The great central market of stocks and bonds, of course, is in New York. The New York Stock Exchange is the pulse of stock and bond trades. At present Thomas W. Lawson is pouring out vials of wrath upon its devoted head. Everybody's Magazine is simply one hot, sizzling flame, apparently right on the victim's stomach.

Aside from what a disappointed plunger says, in turning state's evidence, as it were, the New York Stock Exchange is under fire.

It has been brought out that the manipulation of stocks for inflating or depressing prices is considered legitimate if the manipulators are careful enough to deal with brokers who are members of the Stock Exchange. Further, that brokers hypothecate the stocks of customers as security for their own booms.

This explains why the failure of any stock broker, in and out of a stock exchange, always cleans up the customer.

It teaches one plain thing—that it is dangerous to margin stocks. Of course, that is what all speculators do. They are not content to buy stocks outright. They can't afford to.

One cannot blame a broker for using all the collateral he has in his possession. A recently deceased Chicago bank president had the habit of borrowing money on collateral placed in his possession.

Of course he was gambling and proved to be an easy mark. He had nothing to do but die by his own hand, and his bank quietly accepted a million-dollar loss.

Further, it was shown that the New York Stock Exchange sells its service to the Western Union and then restricts that service to favored customers.

But the biggest cinch that the Stock Exchange has it this. When a member fails, the value of his seat in the Exchange ($95,000) must go toward paying his debts to his fellow members. A defrauded customer comes next and, of course, gets little or nothing.

While this may be contrary to the Sherman act, there is quite a vein of human nature in it.

Men have always clubbed together. Secret orders have been accused of it—even church members.

Speaking of the price of a "seat" on the New York Stock Exchange—it is really a place to stand.

The price of a seat has reached $95,000, but the average cost is around $55,000.

I notice the Gould family has four seats—it seems that it can't trust brokers entirely.

A seat on the Stock Exchange entitles the holder to an even interest in the property during life and a $10,000 life insurance policy; also an interest in the stock quotation service, for which he is charged $20 a month.

Here is where *caveat emptor* comes in—let the buyer beware! When the witness, F. K. Sturgis, chairman of the law committee of the New York Stock Exchange, was asked if he considered it fair for the other stock exchange members to come ahead of other creditors, he said: "Most assuredly I do. Let customers go to a strong house or keep away. They run their own risks."

Whatever the merits of the Stock Exchange controversy, this fact remains: They have served notice of *caveat emptor* —you buy at your own risk. That certainly is commendable—they don't allow you to deal with your eyes closed.

It all gets back to this—there is no easy money. There is no pretense about the aims of New York stock brokers. They simply need the money. They do not deny it. At least they are not hypocrites!

MORAL: A word to the wise should be sufficient.

Practical Telephony for the Practical Exchange Manager

A Series of Articles Relating to the Construction, Maintenance and Operation of a Moderate Size Telephone Exchange, Which Began in the Issue of September 21, Expressed in Everyday Terms, Easily Understood—Principles Easily Applied

By H. R. Van Deventer

To some persons the purchase of a 50-line cabinet for an exchange of three to five lines would seem to be the height of folly. In case of a mere junction point, which is not really an exchange, this may be true, but where these few lines are in a small village, it is extremely probable that in less than one year the number of lines will be doubled, and in three, squared.

Basing an estimate on the average market price of equipment, the initial cost of a 50-line cabinet is not so high after all. The following figures may be of interest.

The cheapest possible arrangement to connect five lines would be:

5 extension bells at $3 each	$15.00
1 5-bar telephone set for operator	12.00
5 cords and plugs at $1.25	6.25
1 plug and cord for operator at $1.25	1.25
5 jacks at $0.75 each	3.75
Total	$38.25

Such an outfit cannot be readily employed for more than ten lines. Hence at the end of the first year, assuming the number of lines doubled, there would be $26.25 worth of equipment useless, as some new arrangement would have to be provided when the eleventh line was installed. In addition to this, the arrangement as shown is not very convenient to operate. No special push button circuits can be operated with it and a night bell cannot be employed. The apparatus would be connected as shown in Fig. 22.

A 50-line floor cabinet, equipped with five lines and three cord circuit, would cost $50

To add each additional drop would cost 3

To add each additional cord circuit, the board being wired for 6 to 10, would cost 5

Complete for ten lines, the board would cost $65

With a couple of extra cord circuits, the cost would be $75. This cost is but little more than the extension bell arrangement. For more than ten lines the 50-line outfit has all the advantage in both cost and desirability. When the exchange exceeds 50 lines, a second board can be purchased and the two boards operated side by side.

For a difference of $11.75, a floor type cabinet, having a capacity of 50 lines and equipped with five lines, can be secured with all the advantages of regular cord circuits, night bell, ringing keys, provision for using special drops

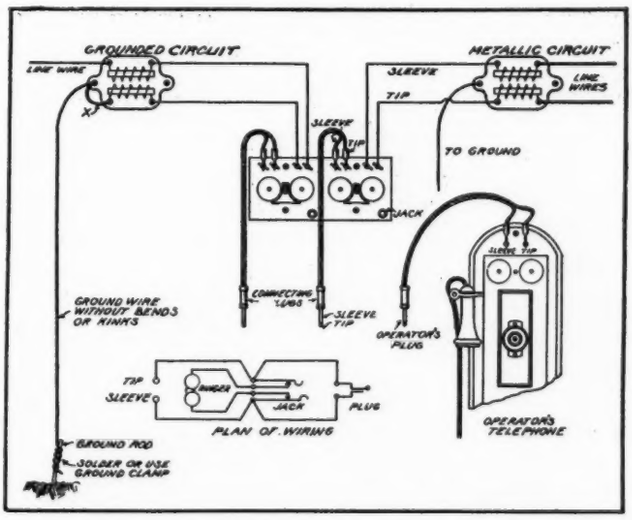


Fig. 22. Connections for Simple Rural Line Board.

for push button circuits; in fact, a switchboard instead of the miscellaneous collection of bells, switches, cords, plugs, telephones, etc., too often seen in small exchanges where anything is purchased, and where once started wrong, no attempt is made to remedy conditions, because "We can't

afford to throw away what we've got." The result is an equipment expensive to maintain, difficult to locate trouble in, hard to operate, unsightly, and utterly inadequate to the requirements of good service. All these may be avoided by a careful consideration of the future when making the initial installation.

One other factor to be carefully ocnsidered in proposed exchanges of any size, is the nature of the traffic and the number of operators necessary to handle it. There are a good many 100-line exchanges that would save money if two operators were employed instead of one. This cannot be done, however, because of a board that will only accommodate one operator. Hence this one poor operator is overworked, the service suffers, and the company loses money on unrecorded toll calls through wrongly made tickets, etc. As an illustration of traffic variation, suppose an exchange of 200 lines, composed exclusively of residence lines with one telephone to a line. Under average conditions, one operator could serve these subscribers, and handle such long distance business as may be necessary. Now, consider a busy place, the business district in some large city. It will be difficult for one operator to handle 80, 50 or even 40 lines if they are brokers' telephones, P.B.X. trunks, etc.

Hence, when installing a plant of 100 lines or more, the traffic should be studied carefully to determine if two operators are necessary. If so, a two-position board may be ordered and the busy lines equally distributed between the operators or one operator may handle the local business while the other takes the toll. In many exchanges one position may be arranged as a desk where the operator can make out all long distance tickets, bills for service, and other records, during idle periods. As this work must be done, the fact that the extra operator does it, means that she simply takes the place of a clerk.

It has been shown that a combination system, magneto and common battery, is possible with the same equipment. Just where to use the magneto and where to use the common battery should be carefully considered.

In using the 24-volt common battery system, it has been the usual practice to limit the line resistance to about 750 ohms. The Bell company has adopted a standard for transmission which is that ordinarily stated as being equivalent to the transmission obtained over a given number of miles of No. 19 B. & S. gage cable, having defined constants and with given terminal conditions. The type of cable used is not the type in common use at the present time, but is the No. 19 gage cable used a number of years ago, when the standards were adopted. The transmission efficiency of the present cable is about 90 per cent. of the standard. That is nine miles of the present cable are equivalent to ten miles of the standard. The standard transmission as usually adopted for local service is 18 miles.

Two factors must be kept in mind where considering the maximum line resistance: *a*, the matter of supplying the transmitter with sufficient current for proper operation; and *b*, securing the operation of the line and supervisory signals.

Just what factor *a* should be, depends upon the internal resistance of the transmitter itself. Its resistance is varied between wide limits. Some transmitters have been made for use on lines of very high resistance and give good results. The average common battery transmitter has a resistance that with a 24-volt battery will give entirely satisfactory results when used on lines of 750 ohms or even much more resistance. However, where much long distance talking is done, the line resistance should be kept within the 750 ohm limit.

The second factor, *b*, is one the apparatus manufacturer can easily regulate to suit almost any requirement. Line signals and relays now on the market easily operate at 24 volts over 750 to 5,000 or more ohms, the upper limit being far above that permissible for transmission operation.

Supervisory relays may also be made to work under the same limits but are usually designed to close at from 750 to 1,100 ohms, and drop off or open with a 10,000 ohm resistance

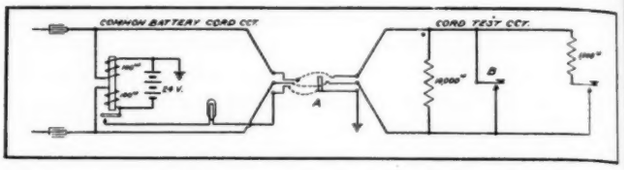


Fig. 23. Common Battery Leakage and Resistance Adjustments.

limit across the line, this shunt representing the permissible leakage. Were it not for this allowance, the supervisory relays would stick, and the operation of the signals would be very unreliable.

In Fig. 23 is shown the way in which the supervisory relays are tested, and it also illustrates the theory of the leakage just described. One side of an ordinary common battery cord circuit is shown. *A* is the test jack, to which is connected the test circuit, representing an actual line. Push button *B* is first operated, thereby short circuiting the test circuit. This throws the maximum current on the relay windings, and if there is any tendency for the relay to stick, it will manifest itself.

The 10,000-ohm resistance represents the total leakage of the line, and with this connected, the relay should not stick or work sluggishly. Button *C* is next operated, and places a resistance of 1,000 ohms across the cord circuit. The supervisory relay should still operate promptly, as this 10,000 ohm resistance represents the maximum line and instrument resistance. Most relays now furnished are adjusted to these or similar limits at the factory and require but little adjustment when placed in service.

As the maximum line resistance should not exceed 750 to 1,000 ohms and the maximum leakage, 10,000 ohms with common battery equipment, all lines having a resistance greater than 1,000 ohms or a leakage less than 10,000 ohms should be magneto, as the common battery apparatus will not operate properly, to say nothing of the falling off in transmission which will take place.

(To be continued.)

Wireless Telephony in Italy.

Experiments have been carried out at Rome, Italy, by the minister of war with new types of transmitter and water microphone, the inventions of Professors Moretti and Vanni, respectively, with a view to opening telephonic communication with Tripoli. The wireless stations at Penzano, Madelena, Palermo and Trepane were telephoned to, and communication was successfully established. The results of the experiments have decided the war department to appropriate the inventions for exclusive military use, a present of them to the government having been made by the inventors.—Zeit. für Schwachstromtechnik.

TO INDEPENDENT AND BELL COMPANIES.

In connection with the information we are now gathering for the forthcoming edition of TELEPHONY'S Directory of the Telephone Industry, we are compiling certain additional and unusual statistics. To the end that this data may be comprehensive and as complete as possible, we ask every telephone company to mail us a copy of its latest directory. We trust all will respond promptly, and assure each that the courtesy will be appreciated. Please address it to TELEPHONY, Monadnock Block, Chicago.

Don't Stop at the Start

By HERBERT KAUFMAN

Get away from the big mob of little men and come on up. Nobody has yet managed to fill out the space between here and the stars.

There's nothing but room overhead. Competition is intense only down below. The hardest struggle is the beginning. The outset of life is the biggest trial. The start takes more time than the race.

If you're sure that nothing will stop you—nothing can stop you. So long as the spirit of fight is in you, you're like a throbbing motor—as soon as you can get belted to opportunity you're sure to drive things.

Everything unusual has to be waited for. The man who built the Washington monument simply piled his stone higher than any one else—he merely kept his head clear and his work straight. What is crooked falls. A straight line is always the shortest. If you doubt it, try to recall anybody who ever got anything or anywhere in any other way. Roundabout short cuts simply make your turn back and start anew.

Being honest is the greater part of achievement. When you know that you're doing the best within you, you can't be downed. Self respect is an eternal life preserver—no matter how often circumstance wrecks you, you're bound to float back to solid ground again.

Success can't be inherited—if you've been handed power or wealth and can't reproduce it of your own accord, you're worse off than the man who had to build both for himself. He can repeat his fortune because he has the tools of experience with which to recreate.

All really big men carved their way with their own muscles and their own brains and their own determination. Mansions and palaces don't incubate producers.

The masters of the world molded their own destinies—they grew great step by step and year by year. They stayed great because every inch of their progress was a contest with somebody else, until they had defeated, by sheer ability, every opponent.

Timber can only be seasoned out in the open where the bad weather can get to work on it—it rots under a shed.

The need and hunger and want of things seasoned three poor ignorant boys into Lincoln, Field and Edison. They became enduring through the opposition of men who already had what they wanted—they became forceful by trying and trying until the last trial was met.

We don't want to help you because assistance doesn't aid. Props merely show inability to stand alone.

We're kindest to you when we make you prove—when we force you to get past handicaps. Jumpers are developed by setting hurdles.

We can't know that you're true-blue until you have stood some of the rains of life and realize that your colors don't run.

When we assist you least we befriend you most—we're teaching you self-development. It's kinder to kick you than to coddle you, because it gives you a chance to kick back, and every time your kicking is harder you gain additional belief in your own power.

Don't stop because the start tires you—you'll soon get used to the strain. The cavalry recruit must stick in the saddle and ride until he doesn't mind the jolting. The oarsman must keep rowing until his blisters grow into callouses.

Keeping on is the whole trick. The pace is secondary—it will develop as you progress. Speed without lasting-power is wasted.

It wasn't the fastest beginner that won the Olympian Marathon. Legs didn't produce the victor—but grit. It was the man whose courage didn't wabble when his knees did—whose tenacity kept him going and held his chest back and his head high.

It was the spirit of "I Will" that drove him to the end—nothing else really counted.

Copyright by Herbert Kaufman.

La Salle Hotel Selected For National Convention

Convention Committee of National Board of Directors Select Headquarters for Annual Meeting, Reserving Two Entire Floors in One of Chicago's Most Modern and Commodious Hotels—Sixty Rooms on Exhibitors' Floor, Placing All on Same Level

The convention committee appointed by the board of directors of the National Independent Telephone Association has designated the Hotel La Salle as the headquarters of the next annual convention of the association, which is to be held in Chicago on February 18, 19 and 20, 1913.

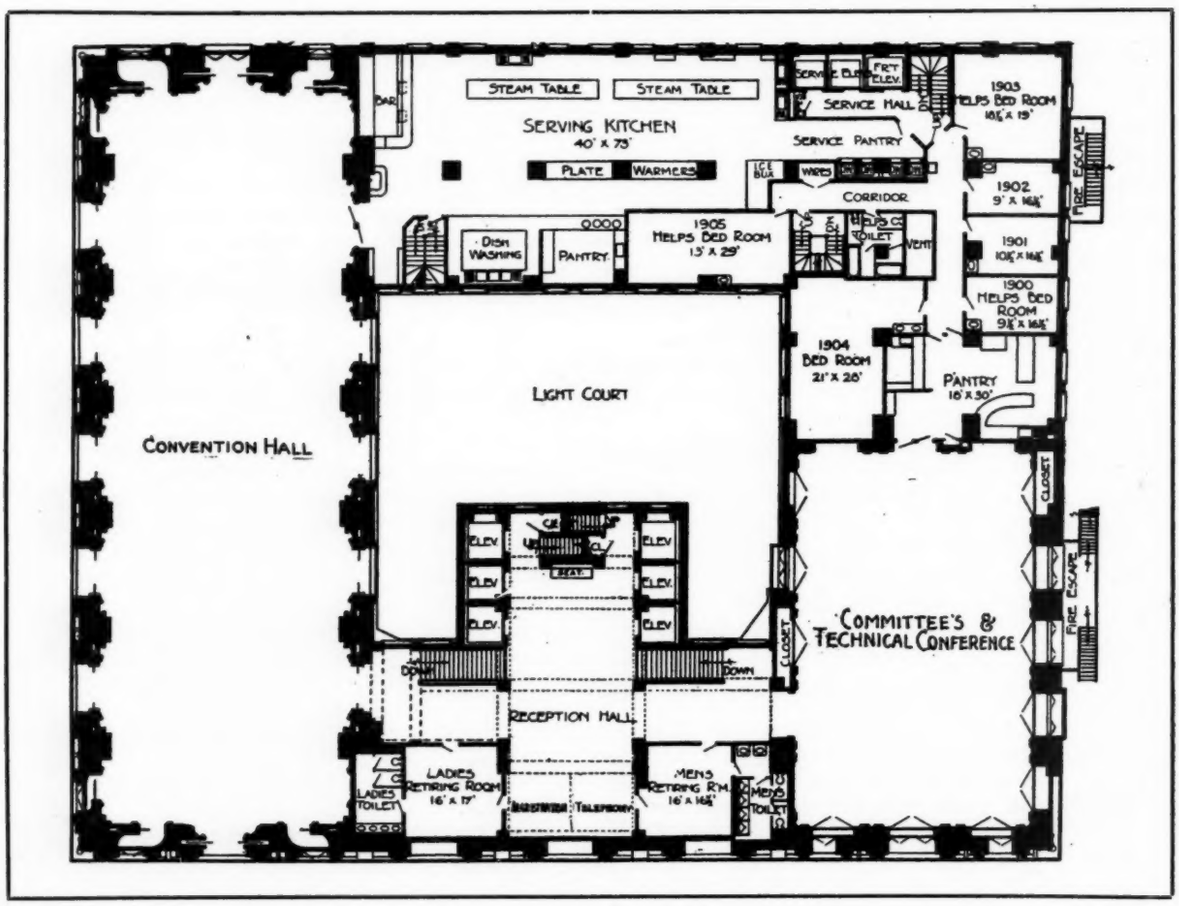
The convention hall, which will be the main meeting room occupies a large part of the nineteenth floor of the building. This is a tremendous, high ceilinged room, which will easily accommodate all delegates. Another, scarcely smaller, will be given over to committee meetings and the sessions of the Technical Conference.

The entire seventeenth floor of the hotel has been set aside for the exhibitors. This was selected instead of the eighteenth for the reason that it has over 60 rooms and will permit all exhibits to be placed on the one level. Plans of both floors are here shown.

The registration desk and TELEPHONY's headquarters will be located just opposite the elevators, as indicated on the plan of the nineteenth floor.

It is urged that all prospective exhibitors make their reservations with the National association as early as possible, in order that all may be cared for and the final details arranged without delay. The best locations will undoubtedly be snapped up at once, and "first come, first served," will be the governing rule. Communications should be addressed to the National Independent Telephone Association, McCormick Building, Chicago.

The La Salle will be remembered by delegates and attendants at the national convention two years ago. It is one of the newest and most modern of Chicago's hotels and its accommodations are of the very highest order. Further details of the arrangements will be given out in TELEPHONY from time to time.



Plan of Main Convention Floor, Hotel La Salle, showing Assembly Room.

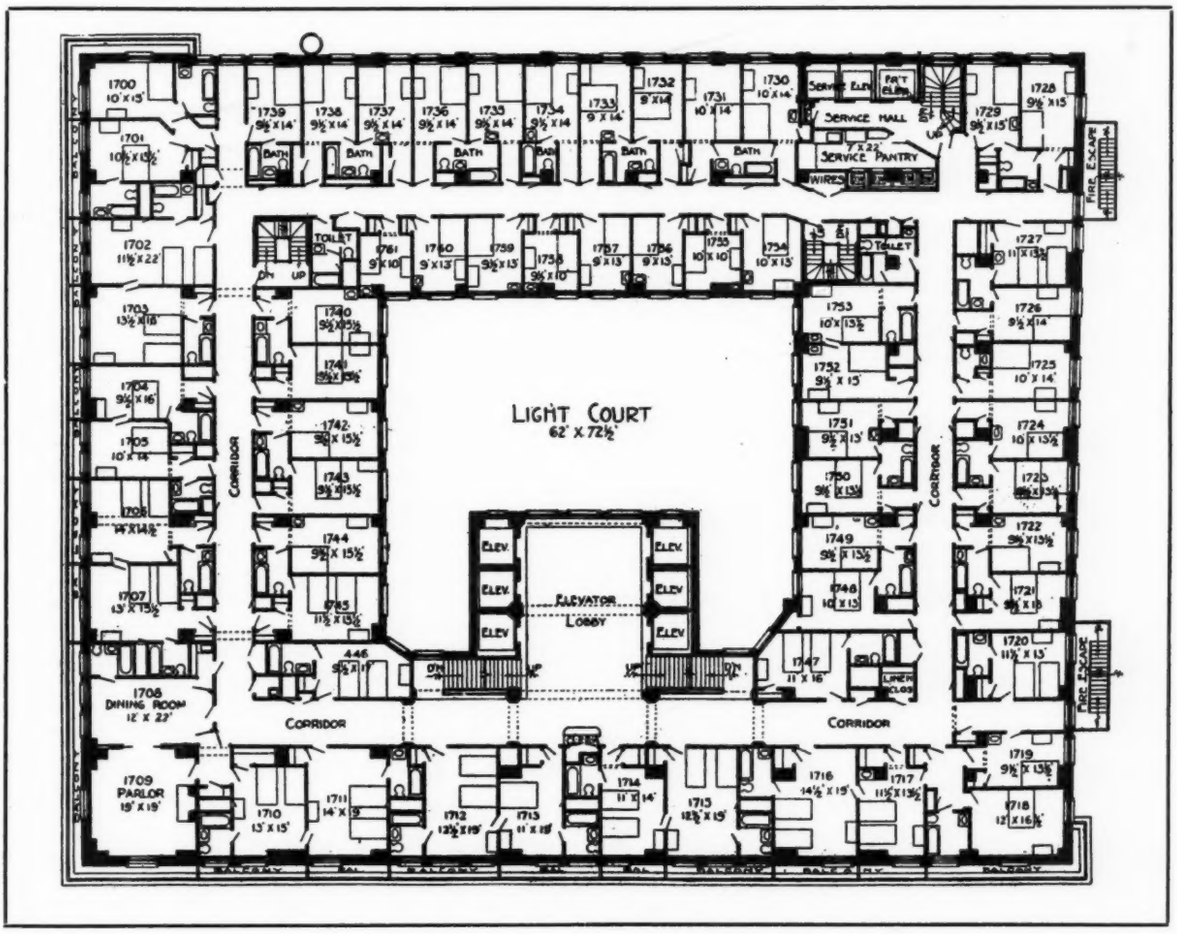
Great Copper Reserve.

The copper industry in the United States has shown a notable growth, according to the United States Geological Survey. In 1845, when important production of copper in this country practically began, the output was but 224,000 pounds, but in increased 100 per cent. the following year and gained by rapid strides until 1850, when the production was 1,456,000 pounds. In 1870 it was 28,224,000 pounds; in 1890 it was 259,763,092 pounds; in 1900 it had increased to 606,117,166 pounds; in 1909 it passed the billion mark, with 1,092,951,624 pounds; and in 1911 it exceeded all previous records with a production of 1,097,232,749 pounds. The world's production in 1911 was 1,958,201,285 pounds, of

which 56 per cent. was the output of the United States.

It is noteworthy that, unlike areas producing most other metals, not one of the leading copper districts of the United States, several of which have been active producers for a period of 30 years or more, has been worked out or showed a marked decrease in its ability to produce copper. Twelve districts situated in eight states have each contributed over 100,000,000 pounds to the copper output of the country, or a total of 94 per cent. of the whole output of the United States since 1845.

Four of these districts are in Arizona, two in California, and one each in Montana, Michigan, Nevada, New Mexico, Tennessee, and Utah. Two districts stand out prominently, the Butte district, Montana, which has contributed over one-third of the output of the country, and the Lake Superior district, Michigan, with a production of a little less than one-third of the total output.



Seventeenth Floor, Hotel La Salle, Devoted to Exhibitors—Over 60 Rooms.

Malay Telephones and Telegraphs.

The Federated Malay States Government Gazette has published the report of the posts and telegraphs department for the year 1911, from which the following items relative to telegraphs and telephones, are taken, the figures being given in United States currency:

During the year 355,853 telegrams were dispatched and 363,759 received for delivery. The total number of subscribers to telephone exchanges on December 31 was 726, an increase of 95. The revenue derived from telephones was $40,862.

On December 31, 1911, there were 1,714 miles of telegraph and telephone lines and 6,199 miles of overhead wires in the Federated Malay States, of which 4,005 miles were telephone wires. In addition, there were 5 1/7 miles of underground telephone cables, containing 536 miles of wire, single line. These figures include 691 miles of telephone wire maintained by this department for the police, but do not include the wires maintained by the railway department for its own use. The posts and telegraphs department also owns 242 miles of telegraph wires in Johore.

Telegraph lines were constructed connecting Salak North with Sungei Siput and Sungkai with Bidor. The line from Kuala Lumpur to Kuala Kubu was extended to Tanjong Malim. Telegraph circuits were also constructed to the new offices at Pudu and Station Street, Kuala Lumpur. Telephone exchanges at Banting and Telok Anson were completed and opened to the public during the year, and one of the trunk lines from Ipoh to Gopeng was extended to Kampar. The new metallic circuit underground system was completed and opened in Kuala Lumpur during the year and a much improved service thereby granted to local subscribers. On behalf of the police department, a new telephone line was provided between Kuala Kangsar and Padang Rengas.

The cost of maintenance was $49,443, and a further sum of $96,455 was spent on construction, of which $32,750 was spent on telephone construction.

The net revenue collected by the department was $399,625. The expenditure amounted to $408,808, annually recurrent expenditure being responsible for $315,048, and special expenditure for $93,760.

Commercial Creosote and Protection of Wood from Decay

Definitions and Classifications of Creosotes—Their Sources and Production—General Requirements Composition and Properties of Creosotes—Quality, Prices and Consumption—Bulletin of Forest Service, U. S. Department of Agriculture

By Carlile P. Winslow

The aim of this circular is to tell the more important sources of wood preserving creosotes, the methods used in their production, their general properties, and the quality, price, and quantity of the creosotes annually consumed in this country. As a whole, it is intended more for the consumer who is unfamiliar with

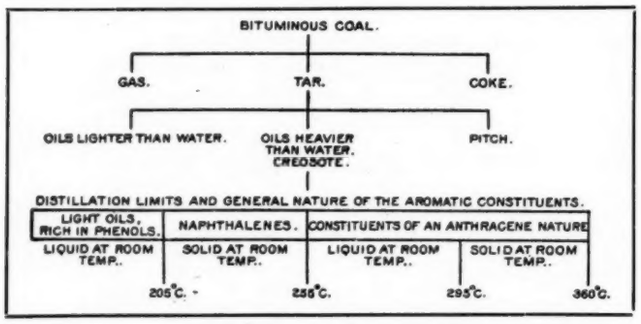


Fig. 1. Derivation and General Composition of Coal Tar Creosote.

the various products sold as creosote than for the chemist or manufacturer, who is well informed on their technical qualities.

For some years the Forest Service has conducted investigations regarding the properties and methods of analysis of various creosotes and the more important of the results secured have been published. This work has been, and will be, continued. The major part completed at the present time, which is embodied in this report, is an investigation of the quality and prices of the creosotes available commercially. For this study, samples of creosote were collected from manufacturers and dealers throughout the country and were critically analyzed. At the same time, information was secured from the dealers as to prices, and statistics were collected on the annual consumption.

Further and more extensive investigations are now under way at the Forest Products Laboratory maintained in cooperation with the University of Wisconsin, at Madison. Samples of a large number of authentic coal tars, oil tars, and wood tars have been collected, from which creosotes are being distilled and critically analyzed and examined. At the same time experiments are being conducted to determine the comparative efficiency of various creosotes as wood preservatives. It is hoped that through this work the wood preserving value of any creosote can be foretold with a fair degree of certainty for any specific condition of service, simply by a knowledge of its physical and chemical characteristics without regard to its source or method of production.

Because of the present lack of knowledge of the properties of all of the various creosotes which may be produced, the terms, definitions, and classifications proposed and used in this publication are subject to criticism and possible future modification. The limits described for the several classes are based on physical and chemical properties possessed by creosotes produced from the sources, or by the methods specified. It is possible that creosotes from other sources may be found to possess similar properties, yet no other method which will indicate the source more satisfactorily than that discussed in this publication is now known to the Forest Service.

Much misunderstanding exists as to the meaning of the term "creosote." It is defined by the Standard dictionary as "a colorless to yellowish oily liquid compound consisting of a mixture of phenols distilled from wood, and having a smoky odor and burning taste. It is a powerful antiseptic and is used for the preservation of timber, meat, etc.; called also oil of wood tar and oil of smoke." Allen, in his Commercial Organic Analysis says: "The name 'kreosot' was first applied by Reichenbach, in 1832, to the characteristic antiseptic principle contained in wood tar. Carbolic acid was discovered soon after by Runge in coal tar, and was long confused with the wood tar principle; and the crude carbolic acid from coal tar is still known as 'coal tar creosote.' Somewhat similar products are now obtained from other sources, so that much confusion has arisen. The term 'creosote,' when used without qualification, ought to be understood as signifying the product from wood tar, but it is better to describe Reichenbach's body as 'wood tar creosote,' and employ the unqualified word 'creosote' in a generic sense as meaning the mixed phenols and phenoloid bodies obtained from wood tar, coal tar, blast-furnace tar, shale oil, bone oil, or other sources."

In its original meaning, therefore, the term "creosote" was applied to a product obtained from wood and the term is still used thus in pharmacy, and refers to a refined product derived from the destructive distillation of beech or other hardwood. However, with the development of both the wood preserving and the coal tar industries, the term "creosote oil," frequently abbreviated to "creosote," gradually came to be applied to the heavy distillates from coal tar. The use of the term has become more and more extended until, at the present time, it is commonly used in referring to the distillates heavier than water from any tars or tarlike substances, and is even erroneously used to cover products containing admixtures of undistilled tar or pitch. As a result of this lax use of the word, it conveys but little to those conversant with the subject and is confusing to those unfamiliar with commercial practice.

More specific terms are evidently needed to properly differ-

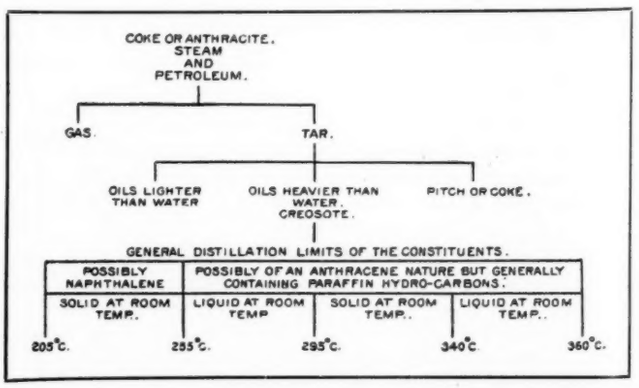


Fig. 2. Derivation and Composition of Water-Gas Tar Creosote.

entiate between the various creosotes. The most useful classification from the wood preserver's point of view would be one based upon the merits of the various products, but lack of sufficient data renders this impossible. The only practical

classification at present must be based upon the source and method of production. The following terms and definitions are suggested, and will be used in this publication:

1. Creosote is a distillate heavier than water obtained by the distillation of a tar or a tarlike substance.

2. Coal tar creosote is a creosote derived from coal tar produced by the destructive distillation of coal at a temperature high enough to produce a tar consisting, for the most part, of hydrocarbons of the aromatic series.[1]

3. Oil-tar creosote[2] is a creosote derived from oil tar. This tar may be obtained from the destructive distillation of petroleum in a gas retort, producing oil gas as a main product and oil gas tar as a byproduct, or by the cracking of gas oil in the carbureter of a water gas plant producing carbureted water gas as a main product and carbureted water gas tar as a byproduct.

4. Wood-tar creosote is a creosote derived from a tar produced by the destructive distillation of wood.

5. Mixed creosote is a creosote produced by mixing other material with a given creosote, such as another creosote, pitch, undistilled tar, or petroleum, or it may be secured by the distillation of a mixture of two or more tars or tarlike substances. In view of the similarity between certain mixed creosotes and creosotes obtained by the distillation of coal tar, produced at temperatures sufficiently low to permit the production of hydrocarbons of the paraffin series, these latter distillates are also classed under this heading. The terms "mixed coal tar creosote," "mixed oil tar creosote," and "mixed wood tar creosote" may be used according to the character of the material which predominates in the mixture.

Production of Creosotes.

Creosotes consist of complex mixtures of organic compounds, which may, however, be grouped into a comparatively few classes distinguished by their characteristic physical and chemical properties. For a more complete discussion the reader is referred to any standard textbook on organic chemistry.

Although there are a variety of tars from which creosotes may be produced, the most important commercial ones may be classified as coal tars, oil tars, and wood tars. The

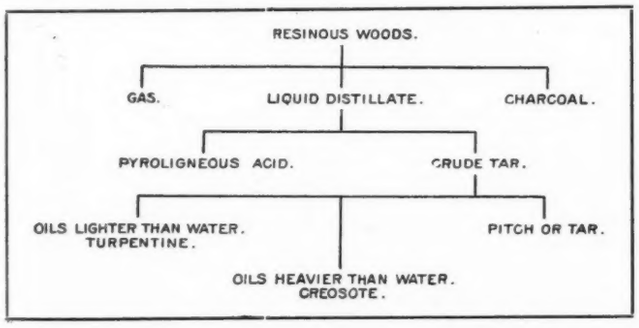


Fig. 3. Derivation of Wood Tar Creosote from Resinous Woods.

sources and general methods of production of these tars are as follows:

Coal Tars.

The important coal tars are derived chiefly from two sources. The destructive distillation of bituminous coal at high temperatures and the combined distillation and combustion of bituminous coal at comparatively low temperatures. The first, which furnishes by far the greater proportion of the total supply, is produced in the manufacture of coke and gas in byproduct retorts and gas house plants. Bituminous coal is destructively distilled at temperatures varying from 1,500° F. to 3,000° F., until the charge has been reduced to coke. During the process the ammoniacal liquor and tar are separated from the generated gases by condensation and washing. The tars naturally vary in their properties according to the character of the coal, and of the retorts, and according to the temperatures used. These factors in turn are largely dependent upon which of the two main products, gas or coke, is primarily desired; tar acids, however, are always present in the tars and usually the temperatures are sufficiently high in both cases to produce tars consisting largely of hydrocarbons of the aromatic series.

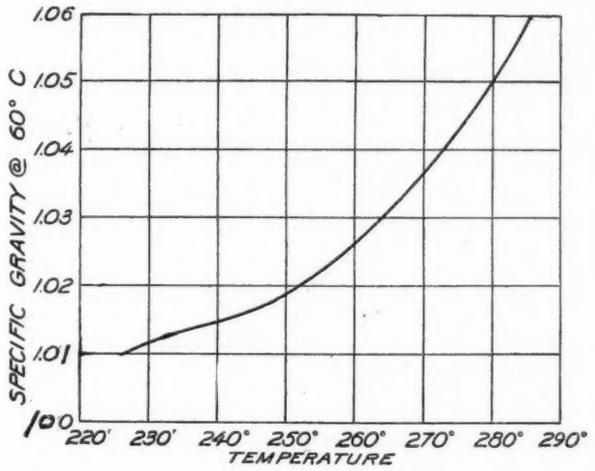


Fig. 4. Lower Limits Specific Gravities of Fractions, Coal Tar Creosote.

Coal tars produced at relatively low temperatures differ from those produced at higher temperatures in the character of their hydrocarbons. Since the temperatures are not high enough to transform all of the hydrocarbons to the aromatic series, the tars contain, to a greater or less extent, hydrocarbons of the paraffin group. Tars secured from blast furnaces using bituminous coal as fuel and from the Mond producer plants, where bituminous coal is used in the manufacture of gas for power purposes, are representative of this group. The production of such tars, however, is not extensive in this country.

Oil Tars.

Of the oil tars, that produced in the manufacture of water gas is by far the most important in its relation to the manufacture of creosote. The method of production is, in general, as follows: The "generator" is charged with coke or anthracite coal, which is burned by the aid of an air blast to a cherry red. The hot gases so formed are passed through the "carbureter" and "superheater," which consist of vertical cylindrical chambers filled with a checker work of fire brick. After these bricks are heated to the proper temperature the air blast is discontinued and steam is blown into the generator.

The gases formed by the contact of the steam with the hot coke or coal pass into the carbureter, into which petroleum "gas oil" is sprayed at the same time. This oil is partially cracked by the high temperature of the fire brick and combines with the gases from the generator to increase their illuminating power; the process of cracking continues through the superheaters. The gas is then passed to the condensers

[1] Creosote secured from coal tar produced at sufficiently low temperature to permit the production of hydrocarbons of the paraffin series might also be included under the name of coal tar creosote, but in view of the paraffin hydrocarbons it is classed in this publication as mixed coal tar creosote.

[2] Inasmuch as the derivatives of oil gas tars and water gas tars contain no phenoloid bodies, the use of the term "creosote" in this connection might, from a purely technical standpoint, be considered erroneous. However, the term is used commercially at the present time in this connection, and a careful consideration of the various definitions used in this publication should prevent any misunderstanding.

and washers, where tar is condensed and collected. This tar differs in its constituents from coal tar produced in the by-product coke ovens and gas retorts both in the absence of tar acids and in the presence of hydrocarbons of the paraffin

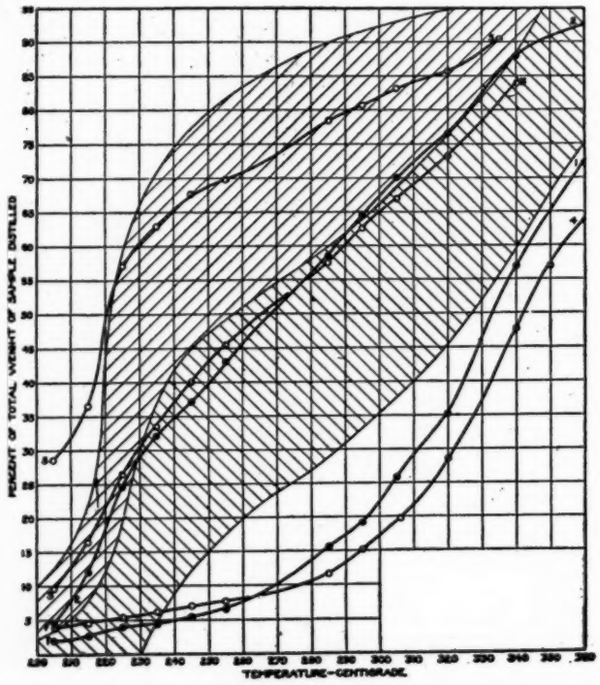


Fig. 5. Fractional Distillation Curves, Mixed Coal Tar Creosotes, Classes 1 and 2.

series; usually, however, the quantity of paraffin hydrocarbons present is comparatively small.

Some oil tar also is produced by the destructive distillation of crude petroleum in the manufacture of oil gas. In tars from this source the quantity of paraffin hydrocarbons present is generally much greater than in that produced in the manufacture of carbureted water gas.

Wood Tars.

Wood tar is produced in a manner somewhat similar to that in which byproduct coal tar is formed. Wood is destructively distilled in retorts, and charcoal is produced, together with gas and a liquid distillate which consists largely of pyroligneous acid and a product called crude tar. The tar and acid are separated by settling and by distillation. Wood tars are quite different from coal tars and contain, in particular, less of the aromatic hydrocarbons.

Distillation of Creosote From Tars.

From any or all of the foregoing tars, either alone or in mixture, creosote may be produced. The general process of manufacture is similar in all cases. The tar is distilled in a metal retort or still and the vapors are condensed and collected. Those distillates which are heavier than water form the true creosotes used in wood preservation. The temperatures at which the creosotes are obtained vary greatly, but generally lie between about 200° and 360° C. The actual temperatures in each case depend largely upon the character of the residue desired. In the United States the manufacture of creosote from coal tar is generally secondary to the manufacture of soft pitch; and in such cases the maximum temperature during the distillation is comparatively low. In Europe, on the other hand, coal tar is distilled largely for the production of the coal tar dyes, and the distillation is carried to higher temperatures. The creosote, therefore, contains a relatively greater amount of the higher boiling constituents than the American product.

As already stated, pitch, undistilled tar, or other similar materials are frequently mixed with a creosote, and while such mixtures are sometimes sold as creosotes, the term is improperly applied except as it relates to the distilled product.

General Requirements of Wood Preserving Oils.

The value of any creosote as a preservative against decay is fundamentally dependent upon its ability to prevent the development of wood destroying fungi. This prevention may be accomplished in either of the following ways:

1. By introducing a material sufficiently poisonous to wood destroying fungi to prevent their development.
2. By introducing a material which will sufficiently exclude moisture or air to reduce the amount of either below that required by the fungi for their development.

In the past the creosotes which have been successful have generally possessed, at least to some extent, both of these properties; but the first is generally considered the more essential. In recent years, however, there has been some tendency to use materials not markedly antiseptic, but primarily intended to exclude moisture. As yet, however, it has not been completely demonstrated, nor generally accepted, that a product can be obtained to fulfill entirely the second requirement.

Aside from these considerations, it is of course essential that the creosote be of such a nature as to remain in the wood for the desired period of protection. In this connection its relative solubility in water and its volatility are important. However efficient it may be in poisoning the food supply or preventing the absorption of moisture, if it will not remain in the wood with a considerable degree of permanence, its ultimate value will be small. Where the treated wood is to be placed in wet situations or under water, as in the case of piling, a soluble preservative is inefficient; and a volatile preservative is especially unsuited for timbers exposed to the air in warm climates.

The relative ease with which a preservative can be injected

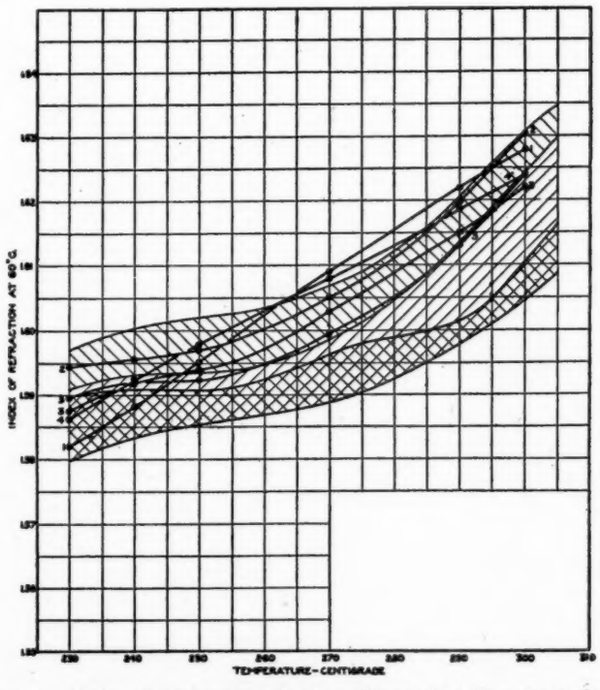


Fig. 6. Index of Refraction Curves, Mixed Coal Tar Creosotes, Classes 1 and 2.

is of much importance in wood preserving operations; for this reason a product which is not sufficiently fluid at temperatures which can be conveniently used at commercial treat-

(*Continued on page* 947.)

The Telephone Inspector and the Troubleman

Continuation of a Series of Articles Begun in the September 7 Issue of Telephony—They Deal in an Elementary and Explicit Manner With Many of the Problems Encountered by Telephone Men in the Operation of Small Exchanges

By A. E. Dobbs

"Here are some sketches," George continued, "which I copied from a Western Electric pamphlet. This one (Fig. 33) shows the method of connecting the drop wires to the line wires where the line wires are supported on brackets. The drop wires are dead ended on separate insulators and the ends left long enough to be connected to the line, as shown in the sketch. Do not set a pole if you have a convenient tree limb from which to swing your wires. In that event, nail two knobs to the limb, keeping them well apart. Suspend the circuit breakers from them with the suspension wire through the hole and tie the line wires in the outside groove. If you have to set any poles, make the farmers dig the holes.

"This sketch (Fig. 34) will show you how to run the wires along the outside of houses in cases where you cannot drop direct from the pole to the place where the wires enter the building. Here is one (Fig. 35*a*) which shows how the wires are attached to the house when dropped direct from the pole. In boring holes through the walls of houses," George went on, "slant the holes upward from the outside so that water will not enter. Insert porcelain tubes through the wall, through which bring the three wires for the line and ground. The leading-in wires are marked *c* and *d* and the drop wires are *a* and *b*. The ground wire *e*,

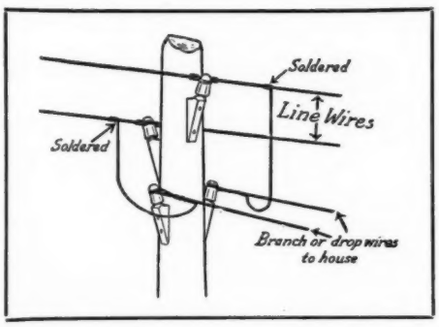


Fig. 33. Method of Attaching Drop Wires to Bracket Line.

which is usually of about No. 12 weatherproof copper wire, should be insulated from the house by knobs as indicated at *f*. Spiral coils, sharp bends or turns should be avoided in this wire. Leave a downward bend in each leading-in wire just below the entrance to serve as a drip loop when it rains.

"In this last drawing (Fig. 35*b*) the whole scheme of connecting the subscriber's set with the drop wires is shown. The protector is placed as near the entrance as possible. In some cases you may be able to find a sheltered place outside the house where it can be installed. Us the No. 19 B. & S. interior wire from the protector to the instrument. We have not received the sets yet, but the size of the boxes will be just about 8 ins. by 20 ins., so that you can make allowance accordingly. Use weatherproof insulated wire for one side of your drops so that there will be no danger of crosses."

"Isn't twisted pair wire used for drop wires?" asked Will.

"Yes, it is," replied George. "In all cities it is the only kind of wire that is used for the purpose, and it is also used to a considerable extent in the country. I did not use it as we have a lot of the weatherproof and also iron wire, which is considerably cheaper."

"Four of these farmers," he continued, "live half a mile back from the road and I will have to make arrangements

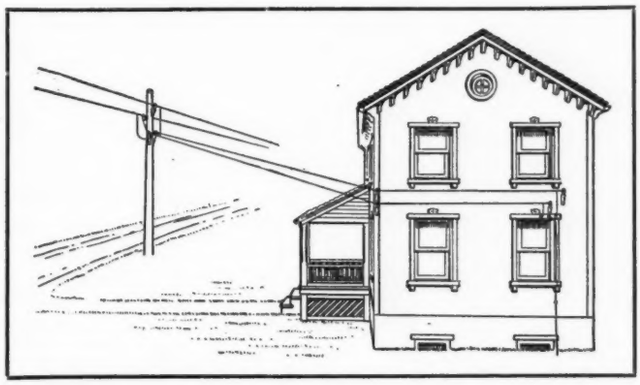


Fig. 34 Drop Wires Run Along the Outside of Building.

for them to build the pole lines which will be located on their land. I intend to work off some of those little poles with 4-inch tops which have been lying around since last spring. But you may go over and wire the houses, leaving enough wire to reach to the pole, and we will later see about the rest."

Mr. Risk came in just after the boys drove off, and, finding George alone, opened the subject of the wires again.

"Don't you think there may be danger of those wires which you have pulled so tight on that toll line breaking? They looked level to me."

"They look level," responded George, "but they are not

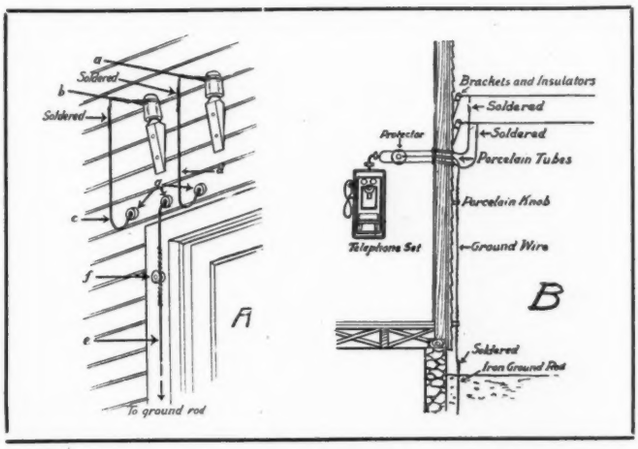


Fig. 35. House Connections to Drop Wires and Instruments.

by some five inches. I told Johnston to pull them up to a four-inch sag, well knowing that, by the time he had finished his connections, they would sag an inch more, as the weather was slightly below the freezing point when we did the work."

"How about the danger of their breaking when the

thermometer goes to ten degrees below zero?" queried Mr. Risk. "We had some wires broken that way once."

THE WIRE SAG IN SPANS.

"The proper rule for pulling wires is to adjust the sag to the temperature. Here is a table I copied from a book and I have found it very convenient to refer to. It shows the deflection for No. 12 copper wire that may be expected at different temperatures. Of course, no one will string wires when it is 30 below zero, nor will they do very much at 100 above. In stringing the wires, the spans should be drawn up to give a sag corresponding to the figures given in the table.

	Span of Feet.				
Degrees Fahrenheit.	100	115	130	150	200
	Sag of wire in inches.				
—10	2½	3	4	5	9
+10	3	3½	4½	6	10½
30	3½	4	5½	7	12
60	4½	5½	7	9	15½
80	5½	7	8½	11½	19
100	7	9	11	14	22½

"In addition to these deflections, the wire will give way about 10 per cent. before breaking and the pole line itself will give a little, so you see our line should be safe under all ordinary conditions."

"By the way," George added, "when is the cable that we have ordered due to arrive?"

"I just received a telephone message from the freight house that it had come," replied the manager.

"When will we receive the telephones?"

"The manufacturer writes they will be shipped day after tomorrow."

"Good! That will enable us to put those farmers on the paying list within the month of January."

"I hope so," said the manager. "That ten-mile line has cost more than $1,500 already."

"That's true," responded George, "if you include the price of your telephones, but the line is easily worth $2,500 today. Why, what are you kicking about! Those farmers are paying you $50 a month, while your toll business will run at least $30 more. That makes $960 a year, and allowing $160 for operating expense, which is plenty, you have $800 to be applied for interest, profits, etc. Really, what have you to complain about?

"Where could we have saved money economically? We might have saved 25 cents on each pole by the use of poles having five-inch tops, but they would have cost us at least twice that long before their usefulness was over. We could have set fewer poles to the mile, but we would also have increased our trouble account. We certainly could not have saved anything on wire, for the long distance people would not connect with inefficient lines. Then it would have only been a short time before they would have built in here themselves and made you merely a toll agent, instead of giving you the favorable terms you have been able to make. In addition, you have a pole line to which you can connect several more farmers without any more expense than the cost of stringing the wire. Thus your income will be increased at small expense.

"As advertising men would say, *'Quality remains when price has been forgotten.'* Those farmers will be the best possible advertising agents because they will be satisfied with the service. Besides, a good, well built line inspires confidence and brings business of itself."

"There is one thing in which you were extravagant," argued Mr. Risk, "that was, the 50-pair cable I let you use, although there are only 26 subscribers out on that line. We could just as well have put on two more arms and strung out No. 14 iron wire for that work."

"There you go again!" exclaimed George. "A 50-pair cable, 1,000 feet long, can be put up for very little money. You might just as well put it up now for you will need it next summer anyhow, as I might as well tell you in strict confidence. This exchange has only begun to grow, and you will have to have a multiple switchboard in another year."

"Tush!" ejaculated the manager. "I have 500 subscribers here now. That is twice as many as the old company ever had, and I have canvassed this town from one end to the other. Besides, I was born and brought up here and I know this town if anyone does, for I used to be in the real estate business. We only have 10,000 population."

"Only 10,000! Why, man, in two years' time you will have 1,400 telephones and you had better begin corresponding with manufacturers right away so that you can have your board ready in time. It usually takes several months to get a board of that kind, after you have made up your mind to buy."

"You may know the town," George went on, "but I know the telephone business. The first thing you know, you will be right up against it unless you get ready to meet the business when it comes. This iron wire that you bought several years ago is nearly gone, and as fast as it wears out you ought to replace it with cable, so as to reduce your trouble account and make it easy to change your system over."

"George!" exclaimed Mr. Risk, "you certainly are a cheerful optimist. Why, last year I thought I was doing a big thing when I had worked my list up to 300 subscribers. 1,400 subscribers! Well, I hope your dream comes true."

"It's no dream, Mr. Risk. I have watched this for several years and I know all it needs is good service and first class construction."

(To be continued.)

Dallas Independent has Spent $1,500,000.

Showing that over $1,500,000 has already been expended and that an additional $250,000 will be necessary to complete work now under construction, J. A. Casler, president of the Dallas (Texas) Automatic Telephone Co., has filed with the Dallas city secretary a statement of the company's expenditures. The statement was filed under instructions of the city commission, issued when the Automatic company recently petitioned the commission for permission to increase its capital stock and to issue additional bonds. The statement shows:

Construction labor, organizing expenses, engineering and superintendence	$ 428,547.84
Real estate and buildings	146,093.19
Central and branch office equipment	232,346.73
Subscribers' station equipment	116,416.42
Subway and underground conduits	153,917.41
Aerial cable	110,506.33
Underground cable	162,762.02
Pole lines	69,603.23
Shops, warehouse, material, tools and vehicles.	19,615.56
Total	$1,439,808.73
Estimate cost of completion of additional lines now under construction	$ 250,000.00
Grand total	$1,689,808.73

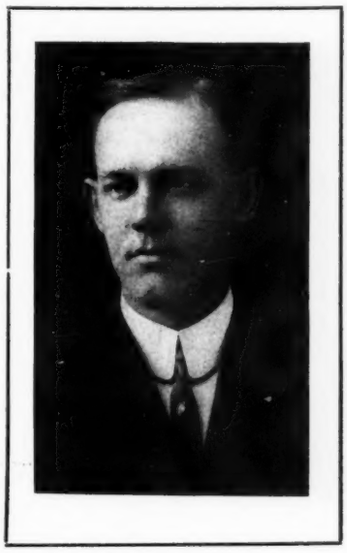
Approves Right to Build Line.

Application of the New York Telephone Co. for the approval of a resolution of the board of chosen freeholders, of Essex county, New Jersey, granting permission to construct a pole line on Mountain avenue, has been approved by the New Jersey Public Utility Commission.

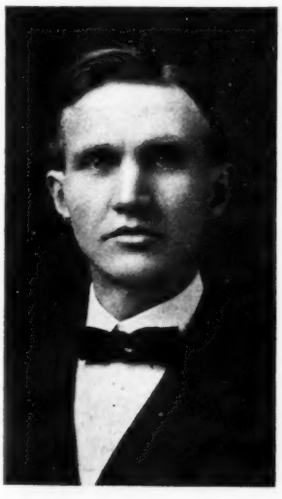
A Quartet of Men Prominent in the Telephone Field

JULIUS C. HUBACHER, vice-president and general superintendent of the Monarch Telephone Manufacturing Co., of Fort Dodge, Iowa, was born in Canton, Ohio, December 11, 1863, obtaining his education in the grade schools of that city. His first employment in the telephone field was in 1899 as general foreman for the Victor Telephone Co. He was one of the organizers of the Monarch Telephone Manufacturing Co., in 1901, becoming vice-president and general manager of the new organization. At that time headquarters were maintained in Chicago and the company manufactured, in addition to its present full telephone line, time stamps and electrical time devices of various kinds. Since removing to Fort Dodge, the latter appliances are no longer manufactured by the Monarch Telephone Manufacturing Co., a reorganization having been effected, and the line confined to straight telephone equipment. Mr. Hubacher is a very well known figure in Independent telephone circles, through his long association with the manufacturing end of the business.

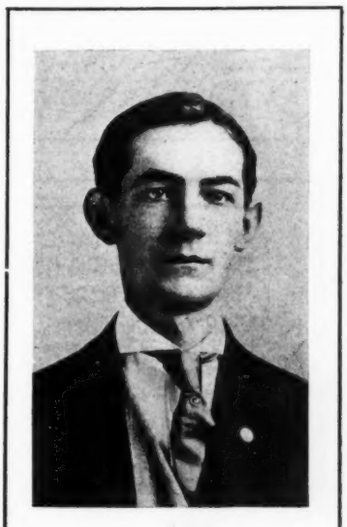
J. C. DUNCAN, president and treasurer of the Peoples Telephone & Telegraph Co., of Knoxville, Tenn., has been associated with the telephone business since his school days. His father, J. C. Duncan, Sr., organized the Peoples company in 1894 and built the system, the younger Duncan working about the plant, installing telephones, etc., after school hours. After the system was in operation he continued work in the repair shop until he left school, in 1897. He then became instrument inspector and, in 1899, was made exchange manager. In 1904 he was made superintendent, with charge of all outside construction, as well as the management of the central office. In 1909 he was elected secretary and treasurer and, in 1911, was elected president and treasurer. In addition to being the head of one of the first Independent companies in the country, Mr. Duncan claims to be operating the only manual call distributing system in the world. He was born in Knoxville November 11, 1879. He is vice-president of the Kentucky-Tennessee Association and a member of the Cherokee Country Club.



CASSIUS M. KELLEY, manager of the Niagara County Home Telephone Co., Niagara Falls, N. Y., was born in Shelby, Ind., September 15, 1869. He was educated in the Coldwater, Mich., high school, the State Normal, at Ypsilanti, Mich., and a graduate of the commercial department of the Ohio Normal University, Ada, Ohio, with the degree of B. C. S. He is a member of the K. P. and M. W. A. Before entering the telephone business he was in mercantile lines for some years. Since 1899, however, his entire time has been given to telephone work, all, with the exception of six months spent with the Central Union, with Independent companies. The record, briefly, is as follows: December, 1910, Hornellville (N. Y.) Telephone Co.; November, 1903, manager Canisteo (N. Y.) Telephone Co.; latter taken over by Federal in 1910, and continued in same capacity until June, 1912, when he was transferred to Niagara Falls, of which the Federal had acquired control. Mr. Kelley says he began digging holes and has successively filled all positions in the business between that and the management.

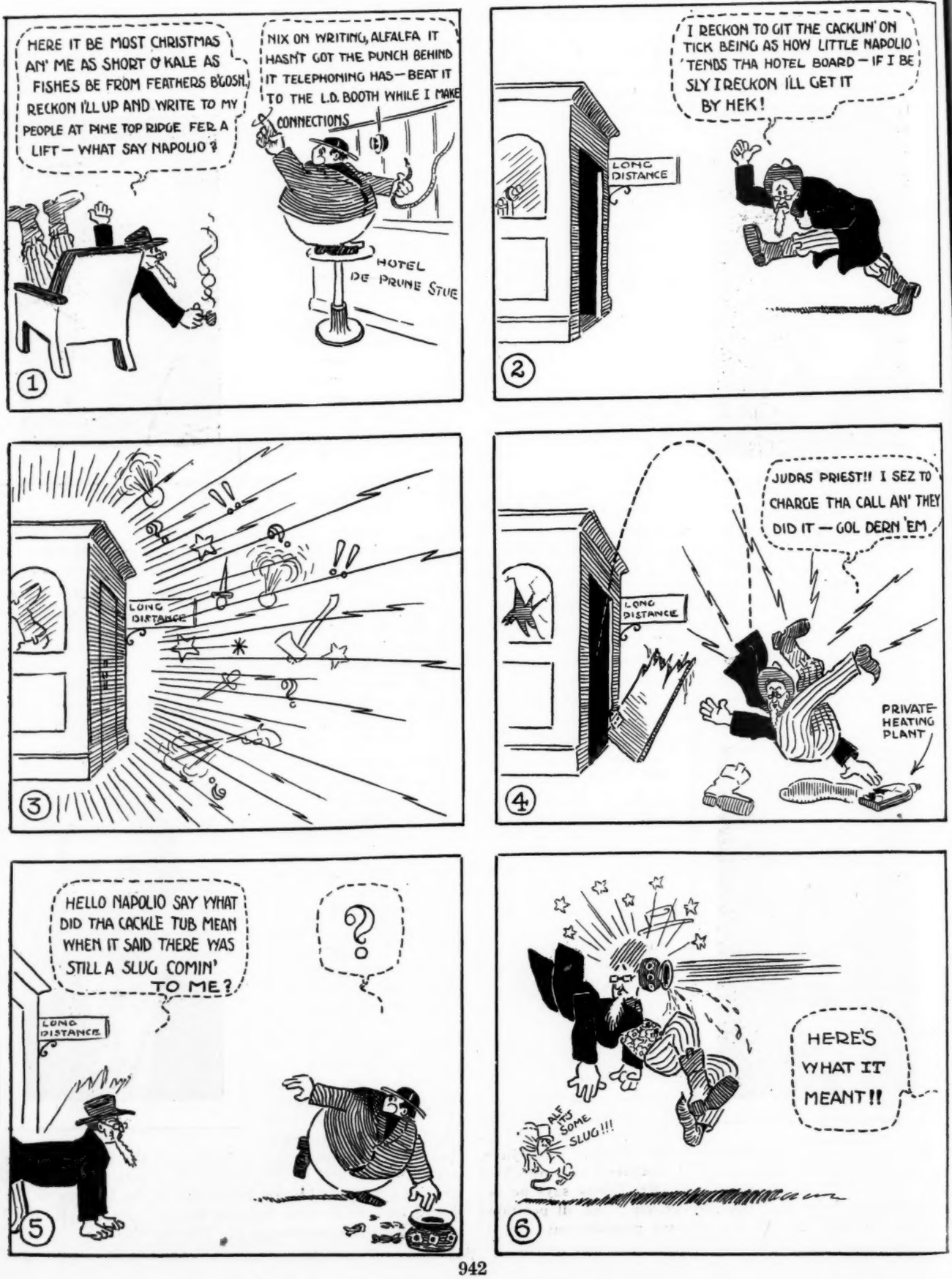


GUY H. POPE, superintendent and wire chief for the Findlay Home Telephone Co., Findlay, Ohio, was born February 25, 1886, in Worthington, Minn. He was educated in the grade and high schools of Bowling Green, Ohio, He has practically grown up in the telephone business, having begun while a school boy building lines all about one section of Bowling Green. He was night operator for the Wood County Telephone Co., at Bowling Green, during one vacation, general utility man for the Central Union the next, and troubleman for the Wood County company the third. After graduating, in 1904, he went to Findlay as assistant wire chief for the Home company. In 1905 he was cable test man for the Bell at Pittsburgh, Pa.; in 1906, wire chief for the Home, at Charleston, W. Va.; in 1907, wire chief for the Huntington, W. Va., Mutual, and cable man for the Bell at Rochester, N. Y.; in 1908 he returned to the Findlay Home in his present capacity. In 1909 he remodeled the Findlay switchboard and cut over to common battery. He is a K. P., D. O. K. K. and a member of the Findlay Cadets.



Telephone Slugs Have a Punch Too, Moans Alfalfa

Words and Music by W. L. Capple

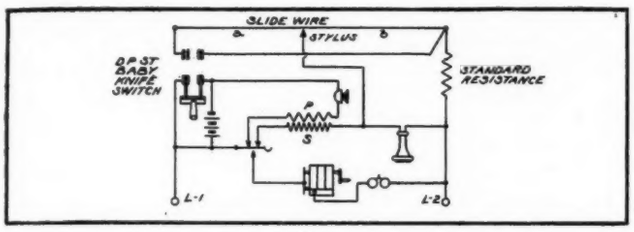

HERE IT BE MOST CHRISTMAS AN' ME AS SHORT O' KALE AS FISHES BE FROM FEATHERS BGOSH, RECKON I'LL UP AND WRITE TO MY PEOPLE AT PINE TOP RIDGE FER A LIFT — WHAT SAY NAPOLIO?
NIX ON WRITING, ALFALFA IT HASN'T GOT THE PUNCH BEHIND IT TELEPHONING HAS — BEAT IT TO THE L.D. BOOTH WHILE I MAKE CONNECTIONS
HOTEL DE PRUNE STUE
1
I RECKON TO GIT THE CACKLIN' ON TICK BEING AS HOW LITTLE NAPOLIO 'TENDS THA HOTEL BOARD — IF I BE SLY I RECKON I'LL GET IT BY HEK!
LONG DISTANCE
2
LONG DISTANCE
3
JUDAS PRIEST!! I SEZ TO CHARGE THA CALL AN' THEY DID IT — GOL DERN 'EM
LONG DISTANCE
PRIVATE HEATING PLANT
4
HELLO NAPOLIO SAY WHAT DID THA CACKLE TUB MEAN WHEN IT SAID THERE WAS STILL A SLUG COMIN' TO ME?
?
LONG DISTANCE
5
HERE'S WHAT IT MEANT!!
ALF TO SOME SLUG!!!
6

Queries on Theory and Practice

A Slide Wire Bridge for Lineman's Test Set.

"I would like to arrange a slide wire or rheostat bridge in connection with a linesman's local battery test set; something that is cheap and serviceable which can be used for locating crosses and grounds on toll and farm lines. If this can be done, I would be pleased to have you show through TELEPHONY some diagram for it."

The combination of a portable telephone and Wheatstone bridge has been worked out in the manner shown in the illustration, but as far as we know, has never been placed on the market. L_1 and L_2 are the line binding posts, as in



Lineman's Test Set—Telephone and Bridge.

any telephone. The hookswitch is provided with one lower contact, which carries the bell and generator. They may be either series or bridging, although series is to be preferred for testing as open and short circuits may be tested by ringing. The induction coil and receiver are in series, with the receiver adjacent to L_2. The primary circuit is as usual except that the battery must be next the hook and L_1.

The slide wire, *ab*, should be either "Advance" or "Manganin" bare resistance wire, in size about No. 30 or 28 B. & S., the former being better as it has a higher resistance. In order to get two or more feet of wire in the slide, it may be necessary to zig-zag it between pins, as has been described before in TELEPHONY. Divide it into about 100 parts or 1,000, if you have the time and patience.

To use the set for ringing, have the knife switch open and the hook clear down. To talk, have the hook up. To use the slide wire to measure the line resistance or any resistance connected between the line posts, L_1, L_2, fix the hook in the middle so as not to touch any of its contacts. Then close the knife switch, and touch the stylus to the slide wire. Keep tapping the slide until you reach the point of silence. If R is the resistance of the standard resistance, a, the number of scale divisions from the left end of the slide to the point of silence and b the number of divisions from the right end to the point of silence, then the unknown resistance will be $X = \frac{aR}{b}$

which is another way of saying, multiply a by R and divide the product by b.

Noisy Lines.

"I have had a great amount of trouble lately with traction noises, due, I think, to ground from the storage battery. The long lines that parallel the traction lines from my test board are very quiet and show by voltmeter test very slight ground. I use local battery test board and my switchboard is common battery. You can call in over one of these lines and it is quiet until the operator puts plug in jack to answer, then the noise is very great. When the operator opens her key to answer, the noise is gone and when she puts up the connection and closes her key, it comes back. I think the ground comes on the line through the supervisor's lights. Our operators' sets both take battery off of separate bus bars, but I think the bus bars are branches of the main bars. If I understand correctly, each line takes battery off of the same bus bars. I have been working these lines with repeating coils, but there are quite a few of them, mostly branch exchange lines, and repeating the coils are too strong and hurt transmission. Can you suggest some way out of the trouble without having to clear that battery off all this ground at the present time?"

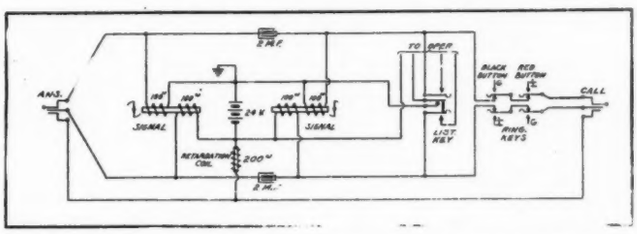
It should not be necessary to take the ground off the battery to clear your trouble, for there are exchanges all over the country operating under bad conditions of exposure and with quiet lines. The fact that the noise is on the line only when the operator's cord circuit is connected and the key is normal must be considered. The operator's talking set is fed from a grounded battery, yet the connection is quiet when the set is connected to the line. It can not come from that source.

The coming of the noise with the throwing of the listening key back to normal looks suspicious, and should be traced to its source, which you can do better than we. Perhaps the springs touch the frame when normal. If you will send us the circuits of the board and operator's set, we can see if there is any chance of the noise coming from the supervisor's lights.

Cord Circuit for Two-Party Line Ringing.

"I would like a sketch of the cord circuit of the No. 9 W. E. common battery switchboard, equipped for two-party ringing, with no master key. Pressing the red button sends alternating current over the tip and pressing the black sends it over the ring. What is the type of the combination two-party ringing and listening key used?"

The drawing shows a cord circuit used with the No. 9 central battery system, equipped with the two-party ringing and listening key. There are quite a number of different kinds of circuits used in the No. 9 switchboard for different classes of service, such as combination, toll to toll, toll to central battery and universal circuits adapted to connect either a magneto or a central battery line, two magneto lines or one central battery line with another central battery line. The standard method of wiring a No. 102-A two-party line, ringing and listening key, is also



Cord Circuit with Two Party Ringing and Listening Key.

shown. It shows the principle of this ringing, which is from either side of line to ground, using ordinary alternating current. The springs operated by the red and black levers, respectively, are indicated.

Big Merger of Bell Companies.

The Southwestern Telegraph & Telephone Co., which recently increased its capital stock to $40,000,000, will take over the properties of the Bell Telephone Co. of Missouri and the Missouri & Kansas Telephone Co. The merger is for the purpose of simplifying operation of Bell telephoe companies in the Southwest by bringing them under one management, with headquarters in St. Louis.

Sparks from the Troubleman's Department

What the Telephone Did for Smith.

By Ray T. Harper.

He was lonesome; he looked it and admitted it. The buzz of conversation in the hotel parlor only aggravated the loneliness.

He sat apart from the guests and thought longingly of home—and then of business—most unpleasantly, for business had made a lonely stranger of him this Christmas Eve.

In the midst of his dreams of home, in which he saw vividly the busy preparations being made for "Santy's" coming and heard the thousands of questions little Elsie and Jack asked, and the thousands of answers and assurances his wife replied, the idea came to him.

So sudden and so welcome was its coming that at first it stunned him, then fairly shot him into action. He strode hurriedly across the room, whispered a few excited words to the girl at the switchboard, startled at his earnestness, paced impatiently back and forth a moment or so until, at her "Long distance, Mr. Smith," he bolted into the telephone booth.

Presently the door of the booth opened. He came forth, his face wreathed in smiles, his eyes sparkling with pleasure.

Why, how the place had changed! Everybody was smiling and happy; he was happy; it was a merry Christmas Eve. He drew up his chair to a joyful group and, leaning over to his neighbor, said earnestly: "Say, I never before realized what a great thing the telephone really is."

The Letter to Santy—a Pictorial Chronicle of Domestic Intrigue.

WRITING TO SANTY
"NO, I DONT WANT ANY BODY TO SEE IT 'CEPT SANTY"
"THE MAIL BOX IS SO HIGH, YOU CANT REACH IT. I'LL TAKE YOUR LETTER"
"OH, LOOK AT THE FUNNY HORSE!"
"I CANT MAKE HEAD OR TAIL TO THIS LETTER"
HE SIMPLY WONT TELL ANYBODY WHAT HE WANTS FOR CHRISTMAS
"AH HA! I HAVE IT. WE'LL CONSULT DETECTIVE BURNS"
"WHY DONT YOU GET HIM TO TELEPHONE TO SANTY INSTEAD OF WRITE
HEL-LO, SANTY, I WANT A PAIR O' SKATES, 'N A FOOT-BALL, 'N A NARYPLANE 'NA—

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Driven to Telephone.

A piece of news too important to wait till night, and too interesting to be committed to the telephone reached the woman about 1 o'clock, so she traveled five miles to her husband's office to relate it in person. She drew a chair up close to his desk and began:

"I came to tell you—"

"Whr-rr-rr," cut in the telephone on his desk.

The man talked into the receiver for about five minutes, then made a few notes, after which his wife resumed, patiently:

"I came to tell you that—"

"Wait a minute," he said. "There goes that confounded wire again."

It went that time and it went again and again, only punctuated between calls by the woman's ineffectual, "I came to tell you." Finally she got up in despair.

"I think I had better wait till night to tell you," she said.

"Yes," he said, "perhaps you had. I seem pretty busy now."

Outside the office the urgency of her message overpowered all other considerations. Profiting by her recent experience she sought the nearest drug store and telephoned her news. He listened in astonishment.

"And you waited to telephone me that?" he said. "Why on earth didn't you tell me when you were here?"

"Oh," said she, "I had a reason."

A Chicagoan who employs a Swedish maid overheard the following conversation the other day between her cook and the maid next door, also a Swede:

"How you are, Hilda?"

"I well, I like my yob. We got cremated cellar, cemetery plumbing, elastic lights—and a hoosit."

"What's a 'hoosit,' Hilda?"

"Oh, a bell rings. You put a thing to your ear and say, 'Hello,' and some one says 'Hello,' and you say 'Hoosit.'"

A telephone lineman was telling of the difficulties he had to meet in constructing a line through a certain rural district. The course laid out included the home of a farmer. After a long consultation the old man and his wife decided to allow the wire to pass over the house, but with the restriction that no one was to use it after 9 o'clock.

"That's our bedtime," they explained, "and we don't want to be bothered with city folks talking late at night." The lineman undertook to keep the city folks quiet.

Clarence A. Swoyer of Columbus, Ohio, starts off on the right foot with this "tip to troublemen:" "Save up your grounds and make yourself a lot." He also allows that, if telephone wires were hollow there might be some people who would want to continually call the brewery.

"There is a young woman of humble parentage and moderate means who has a calling acquaintance with nearly all of the best families in town."

"How did she become so popular?"

"She secured a position in the central telephone office."

Howell—Rowell doesn't speak to his wife.

Powell—And I can remember when he thought it was worth $1 to say a few things to her by long-distance telephone.

Practical Subjects—Letters and Discussions

An Aunt's Letter to a Switchboard Girl.

SMALL COURTESIES.

My Dear June:

Your card of greeting for Thanksgiving brought to my mind on the instant a similar remembrance from a friend.

It is this: "Small courtesies sweeten life; great ones ennoble it." And now I am launched on a lecture you will guess, or this delayed courtesy due to you would not be forthcoming.

In a few words you tell me that you like the telephone work, if it were not for the rudeness of some patrons, and especially of one exchange operator.

Now, a stranger to the work could hardly be convinced that one hard-worked "Central" would lay a feather's weight more of burden upon a fellow-worker. We know, more's the pity of it, that often such cares come in our experience.

You say you have about 150 subscribers. Your cousin counted the telephones in her directory this morning while waiting at her board for daylight to arrive.

She found 380 names. Double your vexations and add a half more. Now, compare your work with hers, and any one near you will hear a great sigh of relief.

In her locality she often has a discourtesy partly healed by the common form of address, "Honey!" which is partly a hurried apology, I believe.

Here is one, and the only way to cure this annoying habit. Never, no, never, repay in "dragon's money!"

Have you forgotten the little story you girls read together, where "getting even" was named that?

You have not forgotten how many hundreds of times it was drilled into your sometimes obstinate, unreasoning young minds, that to do a wrong to get even, put you upon a level with a coarse mind.

So, there you are and, in the hurry of your work, do not forget those lines of Emerson, "Life is not so short but there is always time for courtesy," and, "Good manners are made up of petty sacrifices." But, in this case, one but sacrifices a witty invention of speech, or a show of temper, which latter should never be permitted to enslave patience.

Smooth things out by the gracious tone and word, which is the golden chain binding society together, and, as we have already judged your place as one of the greatest in social structure, set the example. Do not wait to follow. Help to bring back the angel of peace that has wandered too long. "And love so well a high behavior in man or maid, that thou hast from hasty speech refrained."

There is a hidden source, from which the fascination of your personality must flow. Behind all that you do or say must be a grand and lovely womanhood, which will never fail to make itself felt.

Conversation via the switchboard, as elsewhere, has been likened to the hand upon the harp. There is as much in laying the hand on the strings to stop their vibrations as in twangling them to bring out their music. It may be our touch through our voice that brings out the discord.

Nothing can be said that has not been said by some one before. Whether we recall the author or the exact words is immaterial. Someone has said that life is one and universal; its forms many and individual, and since our life has also been, in its train of moods, called a string of beads, a child can see that to pass through we discover many colored lenses, which paint the world their own hue.

Let girls in your peculiarly opportune place slight no chance to make the hues brighter by the simple word of courtesy.

By your perseverance in the retort courteous, raise the acquired genius of your excellence to the height of art, and become a delight to your friends. Cause them to say, "The switch board and its Central are a charming combination."

For, understand, Honey, that the defect in character, which a lack of courtesy shows, would not be remedied in any surroundings, whether it be the central office or the finest drawing room.

And now as we draw near to the happy holiday time if you are that humble but important part of the work, "night operator," as you go to your home in the early morning, it will show you nature reaching out to you her hands filled with health and vigor, and your skilled eye and reverent heart will find joys innumerable. Others less courageous may seek more congenial work, but you must say,

"I seek God's perfect will to do and know,
To wiser, kinder, better, nobler grow,
To error, shine away, truth's beauty show,
And ever to rejoice."

This is my task. Your AUNT.

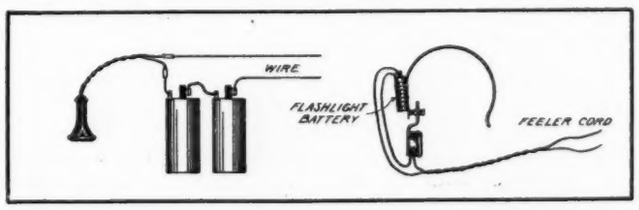
Locating Instrument Trouble.

In TELEPHONY of December 7, C. M. Hamrick describes a piece of instrument trouble in which the instrument was brought to the office to be repaired.

Now, it will be observed that the instrument was a magneto set and consequently had within itself all the necessary apparatus for locating the trouble described, namely, that he could get no battery. The way I test for such trouble is this: First I disconnect the receiver and test it by touching the cord tips to the battery posts. If the receiver is all right a sharp click will be heard. The cord tips are then attached to the binding posts and the cord twisted to make sure it is not noisy. A scratching noise in the receiver denotes a bad cord.

Being satisfied that the receiver and battery are all right, I fasten a piece of wire to one cord tip and another piece to one battery binding post, with remaining cord tip attached to the other binding post. I then place the receiver on the top of the telephone where the battery click may be heard and "feel" the circuit. The place where I fail to get a click is the open. It is supposed that a man who is allowed to fix telephones understands the circuit well enough to feel out the circuit without taking the telephone apart, although I know of wire chiefs who did not know a receiver cord might be short circuited and still allow the subscriber to talk to but not heard from the other party.

I made a 25-mile drive a few days ago, just because I carelessly rang into a bad circuit while I had the receiver down. The instrument I was working on had a way of not performing its transmitting functions, which was positively annoying to the subscriber. When I reached the subscriber's house I tapped the transmitter, holding a



Connections for Testing and Test Receiver.

receiver to my ear to test for packed carbons, and then carelessly gave the generator crank a quarter turn. Immediately the circuit cleared. I hunted for a poor contact without success and finally changed the receiver on the theory that there might be a bad connection in its

wiring. I had to go back to that telephone the next week. That time I resolved to make no mistakes. When I found the telephone dead I started to test, as I have described, and soon run my trouble down to the switchboard springs, the platinum contacts of which were burned.

I have a head receiver with a small flashlight battery connected in series and a long feeler cord which does me more good in testing telephone circuits than a dozen generators could. The battery is taped to the head band, thus making a convenient set.

The wire chief gave me a piece of cutting out trouble a few days ago that bothered me for a week. The telephone was a magneto desk set. I looked at the set and then rang for the wire chief, in the meantime turning down a locknut which was allowing the battery wire full play. I told him that I had found the trouble and he said it certainly talked fine. But next day I was told that the telephone had been reported again. This time I found both the 4-way and receiver cord noisy. I changed them and called in and received an O. K.

Two days later I was told, when out in that neighborhood, to look at that set again. I looked and found nothing. I told the parties that their line had been in trouble that day and that that probably caused their trouble. Sequel—A few days later, when most decent people were hugging their stoves to keep warm, I started out to clean up a bunch of bad connections and had that line on my list. It was an ideal day to hunt trouble—snow blowing so that you could hardly see the top of the pole from the ground. But I got my trouble. It was an improvised test station where one side of the line had been cut, double dead-ended and one end wrapped around the line on the opposite side of the glass. Of course I should have looked the line over the first day, but thought a clear piece of trouble like a loose battery wire was enough for any telephone.

York, Neb. Rufus Comstock.

Letters from a Retired Lineman to His Nephew.

Podunk Valley Farm.

Dear Ben:—

I saw a note in the paper the other day telling of Gen. Grant's report on the surrender of Vicksburg. It was a matter involving the capture of an important fortification, an army, and artillery and ammunition without mention. His report could have been written on a postal card. From what you say there has been enough written about the few miles of line you built, to fill a small book. In your place Gen. Grant would probably have written to headquarters something like this:

"Have finished line to Halifax, Ariz. Tools shipped to Denver. Gang disbanded."

Like on his Vicksburg campaign report, there would have been many questions asked but they would have had a secondary place as to importance.

You say your instructions are to go to Warsaw and build north. All right; put Vicksburg in the background and begin your Chattanooga campaign. At Vicksburg Grant was on the outside trying to get in. At Chattanooga he was on the inside trying to get out. There were those who expected him to "blow up." You are going to be watched more closely than before on this job just as Grant was. Forget the disagreeable finish of your last job and see if you can't make a reputation which will overshadow what you have gone through thus far.

As I have told you I don't think I would be content to live where I could not hear the hum of the telephone wires. I've done a little better than that lately. The livery in the village has gone out of business, and I've had the chance to drive the troubleman along the line once or twice. Yesterday he came out on the early train. His trouble was "8—9—10 crossed." He drove out about six miles and found the trouble at a corner pole.

Number ten pin was broken, and had jumped over number eight. It was evident that this was not the first case of trouble at this point. Slack had been cut into 15 of the 18 wires. This troubleman was at a loss to give a reason for so much trouble at this point.

The corner pole stood at the top of a long hill, and as there were no dead end ties to hold the wires on the lower side, the slack was bound to run downhill. Down in the valley, there was between three and four feet of slack. Be careful about such corners. If they cannot be otherwise located, put in dead end ties and, when necessary, guy the poles with line guys from the top of one pole to the butt of the one above.

You say they are close after your expenses. Twenty-five cents a day on a man does not seem very much, but when you figure on the basis of 200 to 500 men, you see it amounts to a considerable sum. Every tie wire wasted is only about two cents, but 100 means two dollars. By looking at the aggregate amount, one can see the reason for looking after small odds and ends.

A man's fool mistakes are not always a criterion of his calibre. Once when I was going over a piece of line with an inspector, an unusual thing happened. The weather was exceedingly dry. Under the line there was a deep bed of dry grass. Along one side was a withered hedgerow; a regular fire trap, full of drifted weeds and dead limbs.

The inspector was a constant smoker. He lighted his pipe and threw the match down and stepped on it. When we were down the line about ten spans, I looked back and saw a curl of white smoke coming from the hedge.

I called the inspector's attention to it, but he said he guessed it wouldn't amount to much. We went on down the line and put up at a farm house that night.

Right after supper the maddest man I ever saw, came into the yard and inquired for us. It seems that the fire had followed the hedgerow to a rail fence, spread into a stubble field and traveled along aimlessly over some 20 acres until it came very close to the out buildings. The farmer was not at home, and his wife exhausted herself in saving the barn.

Well, the inspector finally settled with the man for $15 and got off cheap at that. That inspector proved later to be a very capable man in an executive position.

While driving along the line with the troubleman, as I mentioned, I have noticed a good many things to which I didn't use to pay any attention. I have noticed several places where there were as many as three and sometimes four sleeves on one wire in a span. How they got there is a mystery to me, for they were all well out of reach from either pole. It must have been done when the wire was strung. The more sleeves the greater, the chance of having more weak points in the wire. The wire is very liable to be burnt at the sleeve, especially if the joint is made in the hurried manner of a reel tender. The sleeve should be given the required number of turns and no more. It is the case of half a turn either way from the required number that is wrong.

Doc. Stuver was up yesterday to buy your brindle heifer, but I guess we'd better hold onto her as long as pasture is good, for I've got plenty of it for what stock I have.

Doc. came here when he was young. I've always wondered why he stayed, so I asked him in a casual sort of way, the other day on our way to the pasture. I'll tell you about it the next time I write.

I find I can buy that colt for $42.50. I don't want to hurry you about the money, still I want you to look at the investment end of the bargain. Your Uncle Dick.

WOOD PRESERVATION.

(*Continued from page* 938.)

ing plants is undesirable. The presence of free carbon is known to decrease the penetrance of creosote and for this reason is objectionable.

Composition and Properties of Creosotes.

The complexity of the many hydrocarbons and their derivatives which may be produced in the destructive distillation of coal, oil, and wood, makes it impossible to state precisely the nature of the various constituents of all creosotes. However, they may be broadly divided into two classes, compounds of the aromatic series and compounds of the paraffin series. The characteristic difference between the two lies in the greater chemical activity of the former. Coal tar creosote consists almost wholly of aromatic compounds, and the long period of successful use of such creosote has led to the general feeling that these constituents are the more desirable.

The compounds of the aromatic series may be divided into three groups, as follows: 1. "Light oils," which distill below 205° C. and consist largely of phenols and cresols, or tar acids. 2. naphthalenes, which distill between approximately 205° and 255° C.; and 3 constituents of an anthracene nature distilling above 255° C, which will be referred to collectively as "anthracenes." Some or all of these are found in most creosotes.

Of these constituents the tar acids possess the highest antiseptic properties; they are, however, soluble in water and are more volatile than the other constituents. The naphthalenes and anthracenes are neither so antiseptic nor

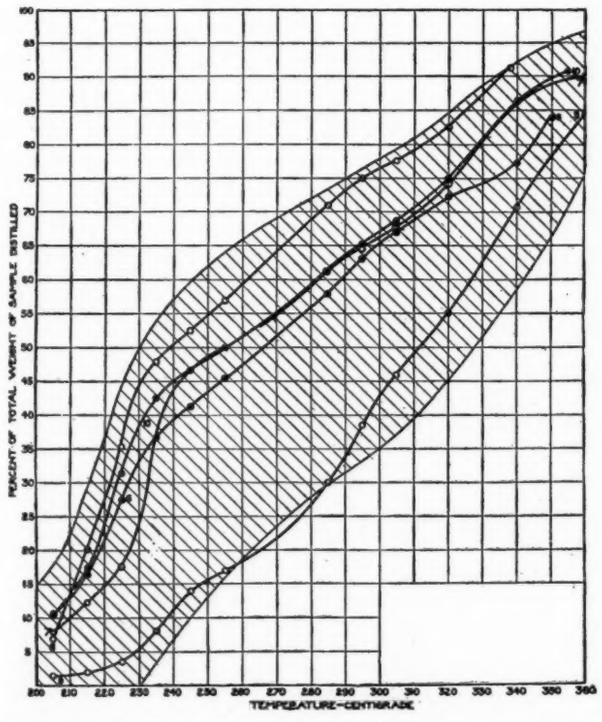


Fig. 7. Fractional Distillation Curves, Mixed Coal Tar Creosotes, Class 1.

so volatile as the tar acids and are practically insoluble in water. There is much discussion as to the relative value of these different constituents, but, largely as a result of experience, the presence of tar acids is believed by many to be essential. While a large proportion of naphthalene is sometimes advocated, particularly for the preservation of piling, a reduction in the quantity of this constituent, with a corresponding increase in the amount of anthracenes, is believed to increase the value of a creosote for general purposes.

Coal Tar Creosotes.

In Figs. 1 and 2 and Table No. 1, the term "solid at room temperature" (20° C.) is used in describing the condition

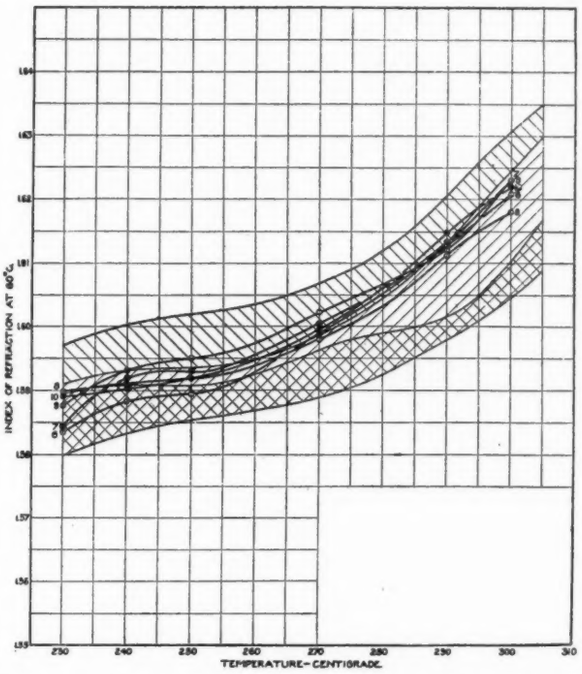


Fig. 8. Index of Refraction Curves, Mixed Coal Tar Creosotes, Class 1.

of certain of the fractions distilled from creosote, when, at the ordinary temperature of a room, they retained their position in the receiving flask when vigorously shaken.

Fig. 1 shows graphically the derivation and general composition of coal tar creosote. The relative quantity of tar acids, naphthalenes, and anthracenes will of course vary according to the character of the tar and the temperatures used during its distillation, but generally the tar acids present will not exceed 5 per cent.; the naphthalenes will comprise from 15 to 50 per cent.; and the anthracenes will comprise the remainder. As previously defined it contains practically no paraffin hydrocarbons. The creosote as a whole is antiseptic, insoluble in water, and somewhat volatile; it is sufficiently free from "free carbon," and fluid enough at temperatures used in commercial treating plants, to offer no great resistance to entrance into the wood.

Water-Gas Tar Creosotes.

Of the oil tar creosotes, that from water-gas tar is practically the only one used for wood preservation. Fig. 2 illustrates its derivation and general composition. This creosote is no more volatile nor soluble in water than coal tar creosote, contains no "free carbon," and offers no marked resistance to entrance into the wood. In fact, water-gas tar creosote may be produced, which on fractional distillation will display a great similarity to coal tar creosote. There is a difference, however, in the constituents of the two creosotes, as shown by the difference in certain physical properties of fractions distilled from them sote is distinctive in the absence of phenols and cresols, and usually in the presence of hydrocarbons of the paraffin group, it is not so antiseptic as coal tar creosote.

Wood Tar Creosotes.

Of the wood tar creosotes, that most used in the past has been secured from resinous woods. The derivation of such creosotes is illustrated in Fig. 3. Lack of authentic data prevents even a general statement as to its constituents, but the proportion of tar acids and volatile constituents is generally greater, and of naphthalene and anthra-

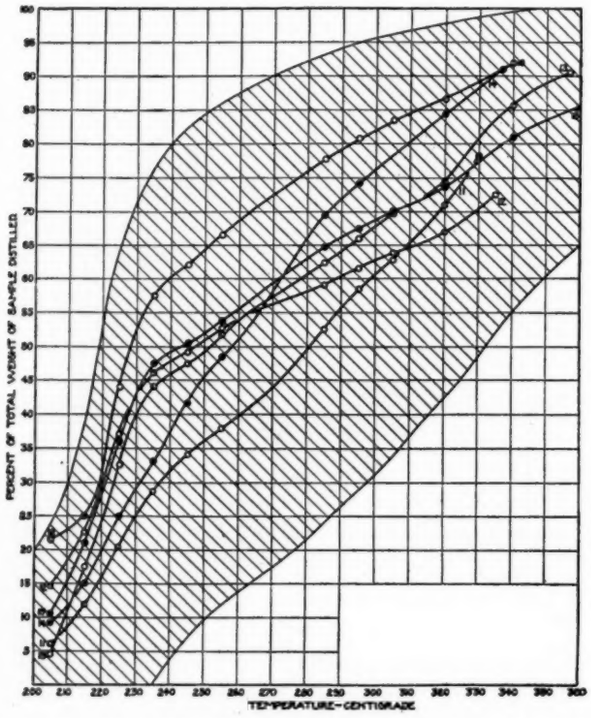


Fig. 9. Fractional Distillation Curves, Mixed Coal Tar Creosotes, Class 2.

cene much less, than in the coal tar creosotes. Wood tar creosotes have been used to some extent as wood preservatives for many years, but partly as a result of their comparatively high cost and limited production and partly through lack of authentic data regarding their efficiency, they do not rank in importance with the other creosotes.

Mixed Coal Tar Creosotes.

A large part of the creosote produced in this country falls into the class of mixed coal tar creosote. Some is made by the mixture of undistilled coal tar, or oil tar, or pitch, with coal tar creosote; some is produced by the partial distillation and combustion of bituminous coal at comparatively low temperatures; and some is secured through the manufacture of soft pitch when coal tar and water gas tar are distilled in admixture. The nature of all mixed coal tar creosotes can not be described, because their constituents and relative merits as wood preservatives vary in each case according to the materials used in their production and preparation. Admixtures of undistilled tar or pitch containing free carbon will, however, tend to decrease the penetrance of the creosote, while the admixture of products which contain appreciable amounts of constituents of the paraffin series will doubtless affect in some measure the antiseptic properties of the creosote.

Properties of Coal Tar and Mixed Coal Tar Creosotes.

Whatever may be the individual opinion as to the merits of the various creosotes as wood preservatives, and no matter what creosote may be selected for use, it is obvious that the consumer ought to have some means of determining the source and nature of the material which he purchases. The Forest Service has not as yet sufficiently investigated all creosotes to permit a definite correlation of their physical and chemical properties with sources and methods of production; but certain characteristic properties of authentic coal tar creosotes and mixed coal tar creosotes, from several sources, have been determined with a considerable degree of certainty.

The more important points to be noted are:

1. In the fractional distillation of the coal tar creosotes, the percentages of distillate coming over between the same temperatures, although varying widely for different creosotes, fell within fairly definite limits.

2. With the coal tar creosotes the fractions distilling above 320° C. did not melt at a temperature as low as 60° C., while similar fractions from creosotes with which petroleum products, such as water-gas tar creosote or the undistilled tar had been mixed, generally melted at that temperature.

3. With certain of the mixed coal tar creosotes secured from coal tar produced by the combined distillation and combustion of bituminous coal at comparatively low temperatures the proportion of tar acids was high as compared to that from the coal tar creosotes.

4. The most constant and serviceable physical properties were the index of refraction and specific gravity of certain of the fractions. These properties of fractions distilling between the same temperature limits were uniformly higher for the coal tar creosotes, or those rich in aromatic hydrocarbons, than for those containing paraffin constituents. As a rule, the greater the quantity of paraffin hydrocarbons present in the fraction, the lower the index of refraction and the specific gravity.

5. The most satisfactory chemical test was the "sulpho-

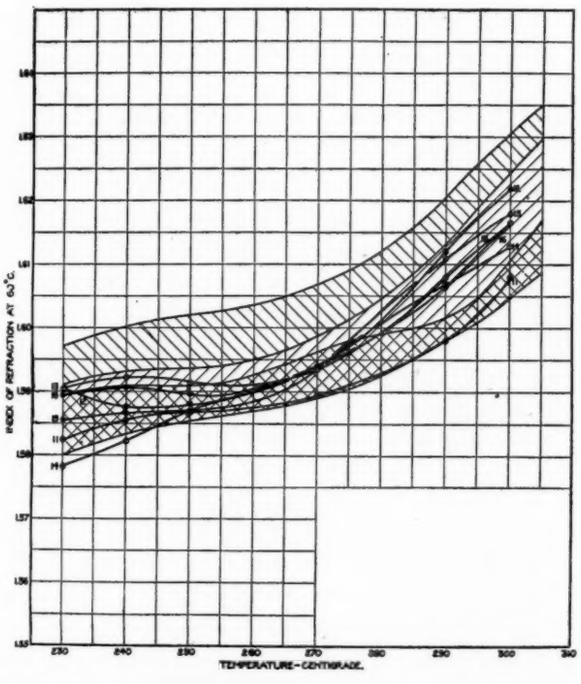


Fig. 10. Index of Refraction Curves, Mixed Coal Tar Creosotes, Class 2.

nation test." The residues from the sulphonation test were larger as the quantity of paraffin hydrocarbons in the creosote increased. This is to be expected, because, with the exception of a possible oily residue, which is readily soluble in caustic alkalies, there is no residue from aromatic hydrocarbons alone.

From these results it was possible to divide the creosotes

which were examined into several classes according to their properties.

Coal tar creosotes consist almost entirely of aromatic

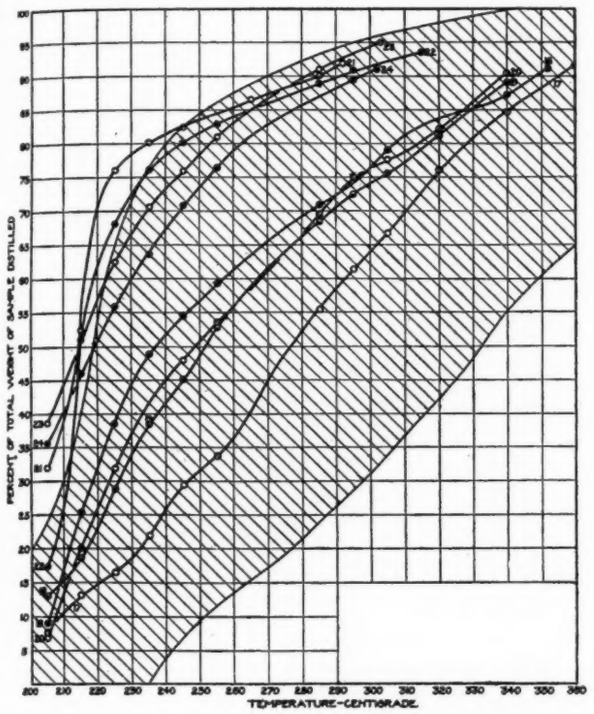


Fig. 11. Fractional Distillation Curves, Mixed Coal Tar Creosotes, Class 3.

compounds, but are divided into two classes, according to the relative proportion of high and low boiling constituents. Their characteristic properties are as follows:

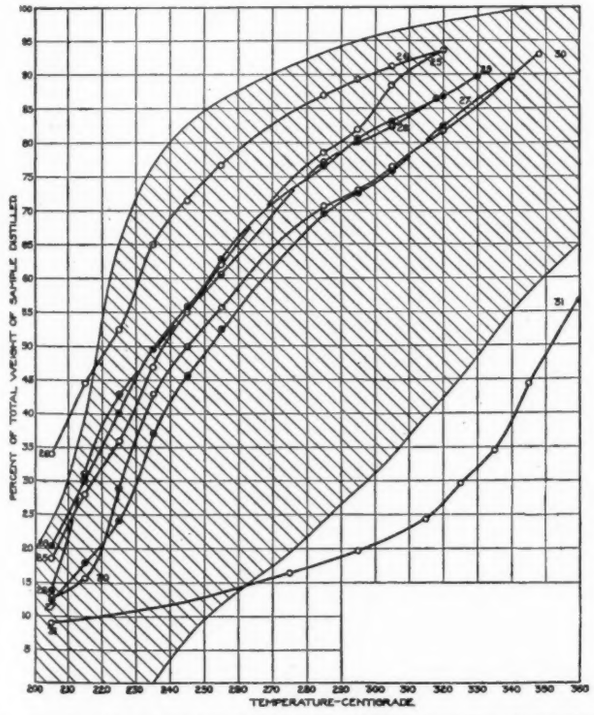


Fig. 12. Fractional Distillation Curves, Mixed Coal Tar Creosotes, Class 3, and Water-Gas Tar Creosotes.

Class 1.—On a fractional distillation the distillation curves fall within the lower shaded area shown in Fig. 5. The indices of refraction at 60° C. of the fractions do not fall more than one in the third place of decimals below the upper shaded area in Fig. 6, and the specific gravities at 60° C. do not fall more than one in the third place of decimals below the lower limit shown in Fig. 4. On applying the sulphonation test to the fractions between 305° and 320° C., there is no oily residue insoluble in caustic alkalies. The water does not exceed 1 per cent. There is no admixture of undistilled tar.

Class 2.—The percentage weights on distillation fall within the upper shaded area shown in Fig. 5. The specifications for index of refraction, specific gravity, and sulphonation test are the same as for Class No. 1. The water does not exceed 2 per cent. There is no admixture of undistilled tar.

Mixed Coal Tar Creosotes.

Mixed coal tar creosotes are divided into three classes, according to the character and quantity of the admixtures.

Class 1.—The presence of a certain amount of oil tar creosote or products of a similar nature is admissible. The

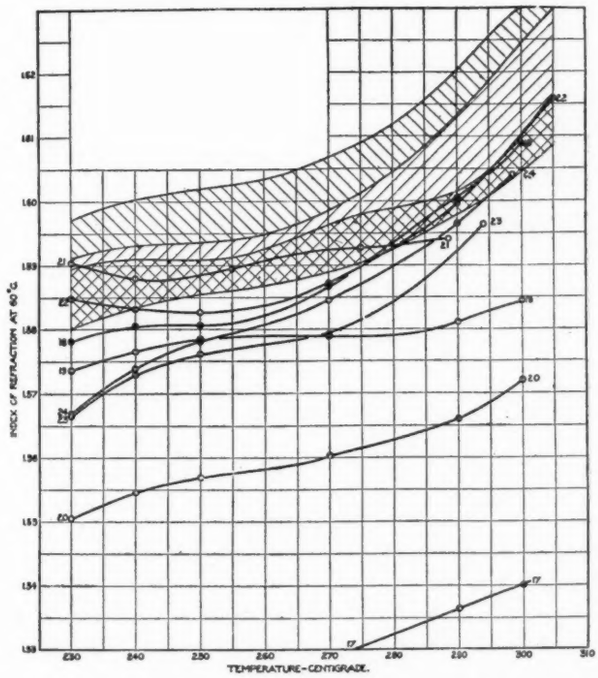


Fig. 13. Index of Refraction Curves, Mixed Coal Tar Creosotes, Class 3.

percentage weights on distillation fall within the shaded area shown in Fig. 7, and the indices of refraction fall within the middle shaded area shown in Fig. 8. The volume of the sulphonation residue, in cubic centimeters, from the fractions, at from 305° to 320° C., is not greater than one-tenth of the weight of the fraction in grams. The water does not exceed 4 per cent. There is no admixture of undistilled tar.

Class 2.—Not only is the presence of certain quantities of oil tar creosote or products of a similar nature admissible, but also adulterations with undistilled tar or other viscous material. The percentage weights on distillation fall within the shaded area shown in Fig. 9, and the indices of refraction fall within the lower shaded area shown in Fig. 10. The volume of the sulphonation residue, in cubic centimeters, from the fractions, at from 305° to 320° C., does not exceed one-fifth of the weight of the fraction in grams. The water in the creosote does not exceed 5 per cent., and admixture of undistilled tar or other viscous material does not exceed 15 per cent.

Class 3.—Mixed coal tar creosotes which, on account of

the quantity of paraffin constituents or undistilled tar or other viscous material present, can not be classified in either of the foregoing classes are included in this class. The properties of such mixtures vary so greatly, according to the nature of the constituents, that they admit of no general description.

Quality of Commercial Creosotes.

To secure authentic information on the quality and prices of available creosotes, the Forest Service, during 1909 and 1910, sought information and samples from a large number of dealers and manufacturers. In most cases these were supplied, and more than 70 per cent. of the firms responded to the request for samples for analysis. No wood tar creosotes were included.

All of the samples received were analyzed and classified, so far as possible, in accordance with the method described. The data secured from each sample are given in detail in Table No. 1 and in Figs. 5 to 14, inclusive. Although the method of examination is not entirely conclusive, all the samples were classified by the same method, and the results ought to give a fair comparison of the characteristics of the various samples.

The reason for putting each creosote in the particular class to which it is assigned will, in most cases, be apparent, but the following explanations are required as to certain of the samples:

Sample No. 1.—Although the index of refraction values of sample 1 fall practically within the limits assigned to coal tar creosotes, the distillation curve falls somewhat below the limits assigned to such creosotes. The analysis seems to indicate that, although the sample was a coal tar creosote, some of the lower-boiling constituents had been removed.

Sample No. 4.—The index of refraction values for the higher fractions of sample 4 have a tendency to fall below the limits assigned to coal tar creosotes, which indicates that the sample may have contained a small admixture of a high-boiling petroleum substance. The distillation curve indicates that, as with sample 1, some of the lower-boiling constituents had been removed.

Samples Nos. 17 and 20.—The low index of refraction values of samples 17 and 20, in conjunction with the high tar-acid content of some of the fractions, indicate that these samples were from creosotes produced from blast-furnace tar.

Samples Nos. 30 and 31.—Samples 30 and 31 were known to be from creosotes produced from water-gas tar; their fractional distillation and indices of refraction are plotted in conjunction with the mixed coal tar creosotes merely for convenience in comparison.

Samples Nos. 27, 28 and 29.—The similarity of the index of refraction values of samples 27, 28 and 29 to those of samples 30 and 31 leads to the belief that they also were water-gas tar creosotes.

Table No. 2 is a classified summary, by regions of supply.

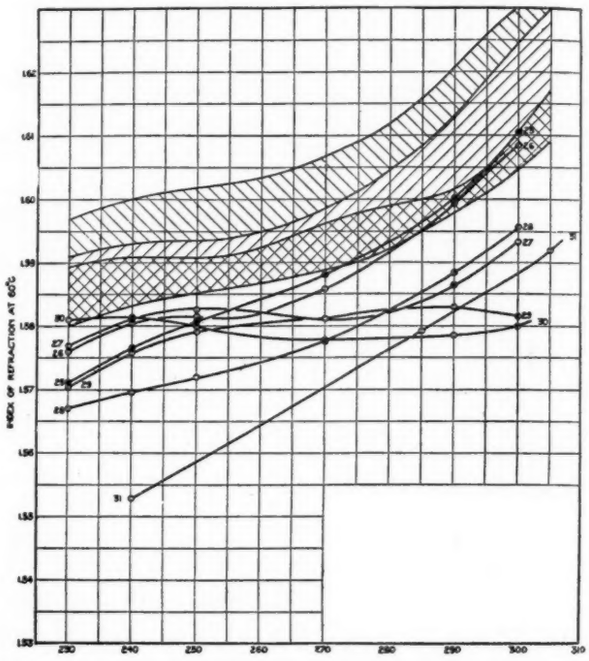


Fig. 14. Index of Refraction Curves, Mixed Coal Tar Creosotes, Class 3, and Water-Gas Tar Creosotes.

It is interesting to note that of 31 samples of creosote received from all parts of the country, only 5 samples, or less than 17 per cent., could be classified as coal tar creosotes, while approximately 80 per cent. were graded as mixed coal tar creosotes. The 2 remaining samples were known to have been produced from water-gas tar. Of the 5 samples graded as coal tar creosotes, 2 were supplied from the East, 2 from the South, and 1 from the Middle West.

Sample No.	Character of the oil.					Character of the fractions.			Character of residue.			Sulphonation residues of fractions, volume of residues (cubic centimeters) given in per cent of weight of fractions in grams.		
	Classification.	Color.	Odor.	Condition at room temperature.	Specific gravity at 60° C.	Distillation limits (°C.).	Color.	Condition at room temperature.	Temperature limits of distillation (°C.).	Color.	Condition.	Fraction 285°–295° C.	Fraction 295°–305° C.	Fraction 305°–320° C.
1	Coal-tar creosote, class 1..	Rich brown.	Not distinctive.....	Viscous liquid.	1.1158	To 305	Reddish.....	Liquid....	360	Dark brown.	Crystalline paste.	(1)	(1)	(1)
						305–320	Dark brown.	Paste.....						
						320–340	Brown.....	Solid.....						
						340–360	....do.....	Viscous liquid.						
2	.....do.....	Brown.....	Like that of naphthalene.	Liquid....	1.0576	170–205	Pink.....	Paste.....	360	(2)	Viscous liquid	(1)	(1)	(1)
						205–225	....do	Solid.....						
						225–235	Yellow.....	Paste						

Table No. 1. Classification and Description of Samples of Commercial Creosotes.

Prices and Consumption.

The quoted prices per gallon f. o. b. works are summarized in Table No. 3. It is only fair to state that the high quotations in the maximum columns under "Middle Western States" were all received from one firm and apply to

what is said to be a special grade of oil. It is unfair, therefore, to compare these quotations with the others and the next high quotations have been inserted in brackets in these columns.

A comparison of the individual figures reveals the fact that in all sections of the country the price for small lots is considerably in excess of that for large orders or tank car lots; increase in individual cases varies from 25 to 200 per cent. In practically all cases the quotations from the Eastern States were lower than for the other sections. In general they differed but slightly from the quotations from the Southern and Middle West sections, yet there is a decided difference when compared to the states west of the Mississippi River. The low minimum quotations for tank car lots in the states west of the Mississippi River apply to the Pacific Coast; in the Rocky Mountain region higher prices prevail as a result of the heavy freight charges on creosote shipped to these points.

Similar statistics were not collected for wood tar creosotes, but the price for small orders is likely to be from 40 to 60 cents per gallon. It is possible that in large quantities wood tar creosote may be secured at a considerably lower figure.

Statistics of the consumption of commercial creosotes do not as a rule distinguish between coal tar creosotes and other closely allied products. However, coal tar creosotes, either pure or more or less mixed with other products, make up the bulk of the consumption, and the figures given in Table No. 4 may therefore be taken to represent the approximate quantity of these creosotes used. It is probable that a small amount of oil tar creosote also is included in the figures.

Region.	Number of firms which submitted samples.	Number of samples submitted.	Coal-tar creosotes.						Mixed coal-tar creosotes.									Water-gas-tar creosotes.		
			Class 1.			Class 2.			Class 1.			Class 2.			Class 3.					
			Sample No.	Number.	Per cent.	Sample No.	Number.	Per cent.	Sample No.	Number.	Per cent.	Sample No.	Number.	Per cent.	Sample No.	Number.	Per cent.	Sample No.	Number.	Per cent.
Eastern States	7	10	3	1	10	5	1	10	.....	0	0	12	1	10	19, 20, 21, 26, 27	5	50	30, 31	2	20
Southern States	6	11	1, 2	2	18.2	.....	0	0	6, 7, 9, 10	4	36.4	11, 13, 15	3	27.2	17, 18	2	18.2	.....	0	0
Middle Western States	5	5	4	1	20	.....	0	0	8	1	20	16	1	20	22, 23	2	40	.....	0	0
States west of the Mississippi River	5	5	.....	0	0	.....	0	0	.....	0	0	14	1	20	24, 25, 28, 29	4	80	.....	0	0
Total	.....	31	.....	4	13	.....	1	3	.....	5	16	.....	6	19	.....	13	42	.....	2	7

Table No. 2. Classification of Samples of Commercial Creosotes.

Region.	Number of firms addressed.	Price per gallon f. o. b. works, including package.								
		1-barrel orders.			60-barrel orders.			Tank-car lots.		
		Number of quotations.	Maximum.	Minimum.	Number of quotations.	Maximum.	Minimum.	Number of quotations.	Maximum.	Minimum.
			Cents.	Cents.		Cents.	Cents.		Cents.	Cents.
Eastern States	13	5	15	7	5	12	7.5	5	12	5.5
Southern States	9	5	20	9	3	16	12	6	12	6.7
Middle Western States	7	4	[1] 60 [20]	12	3	[1] 40 [12]	10	4	[1] 40 [9]	5.5
States west of the Mississippi River	7	5	25	20	4	19	16	4	15	[2] 6.7

[1] These figures apply to what is said to be a special grade of oil. Figures in brackets are next highest quotations received.
[2] This low quotation is from a firm on the Pacific coast, and applies to an imported product.

Table No. 3. Prices of Commercial Creosotes.

Year.	Domestic.	Imported.	Total.
	Gallons.	Gallons.	Gallons.
1903 [1]	4,000,000	3,711,565	7,711,565
1904 [1]	4,850,000	3,785,472	8,635,472
1905 [1]	5,800,000	7,750,531	13,550,531
1906 [2]	17,360,000	38,640,000	56,000,000
1909 [2]	13,862,171	37,569,041	51,431,212
1910 [2]	18,184,335	45,081,916	63,266,271

[1] The figures for 1903, 1904, and 1905 were taken from Forest Service Circular 98, and apply to coal-tar creosote. The domestic supply figures are from estimates by Prof. Gellert Alleman. Imports are from the annual reports of the Department of Commerce and Labor.
[2] The figures for 1906, 1909, and 1910 are from Forest Service Circular 185 and were compiled from reports on the consumption of creosote received from more than 90 per cent of the treating plants in operation during these years.
No figures are available for 1906 and 1907.

Table No. 4. Consumption of Creosotes.

The statistics are represented diagrammatically in Fig. 15, which shows the strikingly rapid increase in the consumption of creosote, as well as the relatively small quantity produced in this country. In 1903 and 1904 the domestic production exceeded the imports, but since that time, although the annual consumption of domestic creosote has practically quadrupled, the imports have rapidly outstripped the domestic production, and in 1910 exceeded it by almost 150 per cent.

It is not difficult to find the reason for this condition. In Europe the refinement of coal tar is conducted largely for the production of coal tar dyes, and this does not interfere with the production of a good grade of creosote. On the other hand, in the United States where the prime object is the production of pitch, the only creosote produced is that which will not interfere with the character or amount of the pitch. Furthermore, byproduct retorts are more extensively used throughout Europe than in this country, where large quantities of coal are coked in the beehive ovens with a loss of the possible byproducts.

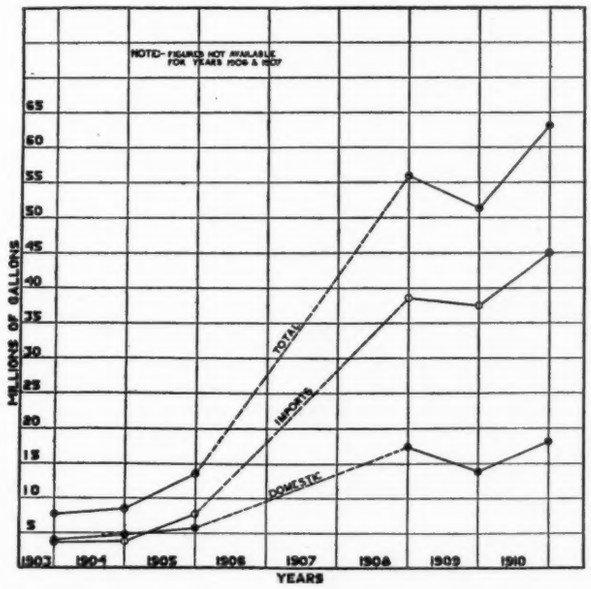


Fig. 15. Consumption of Creosotes in the United States.

There is no reason to doubt that more than enough creosote might be produced in the United States to supply the present demand. Statistics published by the Geological Survey show that in 1909 practically 60,000,000 gallons of

tar were produced in the manufacture of coke in byproduct coke ovens, and although no statistics are at hand showing the tar produced at the gas house plants for that year, the total production of gas house tar in 1907 and 1908 was greater than that from the byproduct coke ovens. It is safe to assume, therefore, that the total amount of coal tar produced in 1909 was at least 100,000,000 gallons. Assuming that 5 gallons of tar will produce 1 gallon of creosote, the total amount of coal tar creosote which might have been produced is approximately 20,000,000 gallons, or about 50 per cent. more than the domestic creosote consumed that year. This possible production could be further vastly increased by the wider use of the byproduct retorts. The average yield of tar from the bituminous coal coked in the byproduct ovens in 1909 was 6.4 gallons per short ton; the approximate quantity of bituminous coal coked in the bee-hive ovens during that year was 51,000,000 short tons. Had this coal been coked in byproduct ovens, approximately 326,000,000 gallons of tar might have been produced, or an amount sufficient to provide more than 65,000,000 gallons of coal-tar creosote. This amount exceeds the total consumption for that year by more than 13,500,000 gallons.

The Geological Survey reports the production of 9,168,834 gallons of oil and water-gas tars in 1908, but the report states that "most of the tar is used for fuel at the works, no record being kept of the output." Substantiating this theory, it is then stated that "in addition to the amount above listed, over 5,500,000 gallons were reported in 1908 as made and not sold." Only recently has oil tar creosote been marketed under that name. Statistics of the production or consumption are not available, but it is undoubtedly much in excess of the figures given.

Wood tar creosotes do not at present rank in importance with the coal tar creosotes. Although the quantity of wood tar produced in 1909 was approximately 20,000,000 gallons, an amount capable of yielding approximately 2,000,000 gallons of creosote, a large portion of this tar was consumed as fuel, and the quantity of wood tar creosote actually produced was much less than the possible production.

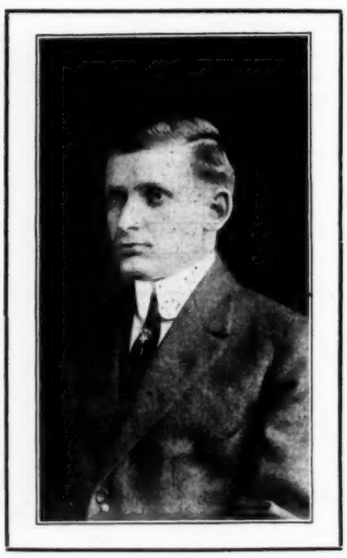
From Factory and Salesroom

Conventions: National Independent Telephone Association, Chicago, February 18, 19, 20; South Dakota Independent Telephone Association, Sioux Falls, January 8, 9; Northwestern Cedarmen's Association, Duluth, Minn., January 7, 8; Convention of Independent Telephone Men, Pittsburgh, Pa., January 16

Boyd Now Kellogg Sales Engineer.

The many friends of C. D. Boyd, of the Kellogg sales force, will be glad to know that he has been given the special work of sales engineer for that organization.

Mr. Boyd's long experience in the telephone field, especially in Indiana and Michigan, has made him a great enthusiast on the subject of Kellogg apparatus reliability. His favorite sales argument is the actual telephone experience of those who have personally handled Kellogg telephones and switchboards. His enthusiasm is more than interest; it is absolute confidence in what the equipment bearing this name plate will do. This is illustrated in many of his successful sales, where he has presented the "show me" idea in an unfailing argument. When it comes to competitive bids, his idea of a sure sales test is to simply be allowed to present his apparatus in actual trial with telephones of his competitors. "Kellogg transmission" needs no argument.

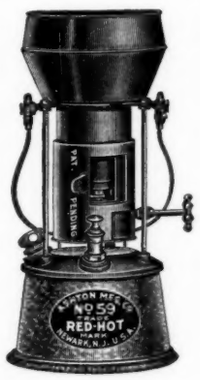


C. D. Boyd.

Here is the way he sums up the proposition: "The only thing about Kellogg that you can't buy is the name plate, and that represents unquestioned quality and character."

A New Ashton Fire Pot.

The Ashton Mfg. Co., of Newark, N. J., maker of the Red-Hot line of fire pots and torches, has added another new and useful fire pot to its line, realizing that the demand was growing for a first class fire pot, using kerosene as fuel. It has placed upon the market its new No. 59 Red-Hot Kerosene Fire Pot, which is guaranteed by the maker to be first class in every respect and to give satisfaction.



No. 59 Fire Pot.

The tank is made of heavy galvanized iron, with cast top plate and bottom ring, braced with rod running from the center of the top to the base of the tank, making it strong and durable, and it is fitted with patented automatic brass pump, insuring constant air pressure.

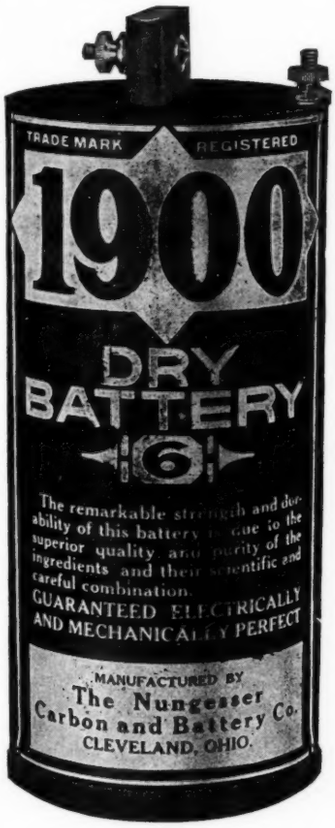
The burner is made of special bronze generator metal controlled with needle valve fitted with packing nut and produces a steady blue flame of intense heat. The No. 59 Kerosene Red-Hot Fire Pot is guaranteed to work perfectly out doors in wind or zero weather, as the flame is protected by a metal slide or shield.

The Red-Hot line is sold everywhere by leading jobbers under the maker's guarantee. A free catalog showing our complete line will be mailed upon request.

The Dean Electric Co., of Elyria, Ohio, will shortly issue its annual call to the salesmen to gather at the factory. The company assembles its men from all parts of the field every year, and has a general discussion as to sales, products, etc.

Federal Trucks Strong on Pacific Coast.

It is evident, by the way the Standard Motor Car Co., of San Francisco, is sending in car orders, that Federal trucks are meeting the requirements of motor trucks on the Pacific Coast. A motor truck to meet this demand must be sturdily built, with a motor of exceptional power, better than the average, to overcome the steep grades, frequently encountered in that region.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1900
DRY BATTERY
6
The remarkable strength and durability of this battery is due to the superior quality and purity of the ingredients and their scientific and careful combination.
GUARANTEED ELECTRICALLY AND MECHANICALLY PERFECT
MANUFACTURED BY
The Nungesser Carbon and Battery Co.
CLEVELAND, OHIO.

All that the best battery should be—all that you demand in battery efficiency and service is embodied in the

TRADE MARK REGISTERED
1900

20 years of constant endeavor to improve. Highest quality of raw material. The combined efforts of master-chemists and expert engineers. The policy of the 4 tests—each battery is subjected to 4 separate tests before it is put out as *right*. The shipping of only fresh made cells—these are the basic facts which have made the 1900 the *perfect* battery.

This is our foundation—this is what has given you efficient battery service and why the 1900 batteries are *making good* in scores of cases where others "just as good" fail.

Ask your jobber or write us for the battery that means longer and better service—the 1900.

The Nungesser Carbon & Battery Co.

2500 King Ave., N. E., Cleveland, Ohio

Roebling Telephone Wire

can be obtained from stock in Roebling warehouses at Trenton, N. J., New York, Philadelphia, Pittsburg, Savannah, (Office Atlanta) Cleveland, Chicago, San Francisco, Los Angeles, Seattle and Portland, Oregon.

This applies to Double Galvanized, Hard Drawn Copper, and Copper Clad Steel Wire, also Galvanized Strand

Made by

JOHN A. ROEBLING'S SONS CO.

TRENTON, N. J.

MILLIONS Of Dry Cells Are Handled In This Territory

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Direct from Madison, Wis.

There is no reason why the dry cells *you* use should get old in transportation and stock rooms before you install them.

Your orders will be shipped the day received.

Send for new price schedule.

FRENCH BATTERY & CARBON CO.

Madison, Wis.

Please tell the Advertiser you saw his Announcement in **TELEPHONY.**

In the last year the Standard Motor Car Co., of San Francisco and Los Angeles, has purchased and sold 85 Federals in and around these two cities; and this week they come back with an order to rush 28 model "D" chassis. By this showing, Mr. Pulcher, general manager of the Federal Motor Truck Co., of Detroit, Mich., is of the opinion that the Federal has overcome the difficulties encountered on the coast which have hampered the sale of other motor trucks there.

A Well Put Up Calendar.

The Nungesser Carbon & Battery Co., of Cleveland, Ohio, is already in the field with its 1913 calendar, a striking production in colors. It is a distinctive production, not only on account of the design calling attention to the "1900"

A Calendar With Desirable Features.

battery, but also because of the "baby giant" character of the calendar pad. The latter is only three inches square, yet the figures are large and easily read from a distance. The company will be glad to send one of these little calendars to any one interested in batteries, upon request.

British Electrical Trades Directory Preparing.

The Electrician Printing & Publishing Co., Salisbury Court, Fleet street, London, England, is now engaged in the preparation of the thirty-first edition of its Electrical Trades Directory and Handbook. This volume, which is printed annually, aims to cover the electrical field of practically the entire world. The compilation of a work of this nature is, obviously, a tremendous task and the publisher asks that every assistance be given.

Preliminary Report of Poles Purchased for 1911.

A preliminary statement showing the number of poles purchased by the telephone and telegraph, steam and electric railroad, and electric light and power companies in the United States during the years 1911, 1910, 1909, 1908 and 1907 has been issued by Director E. Dana Durand of the Bureau of the Census, Department of Commerce and Labor. The report was prepared under the direction of William M. Steuart, chief statistician for manufactures, by Jasper E. Whelchel. The data were collected in co-operation with the Forest Service of the Department of Agriculture, and form one of a series of annual reports regarding the lumber and timber industries.

Decrease in Number of Poles Purchased.

While the total purchases of poles in 1911 was less than those for 1910 and 1909 by 452,674 and 320,720 respectively, it exceeded the totals for 1908 and 1907 by 168,866 and 134,752 respectively. The decrease in the 1911 totals as compared with that for the preceding year was confined entirely to a falling off in purchases by telephone and telegraph companies and steam railroads, while a substantial increase in purchases was made by electric railroads and electric light and power companies. The decrease in 1911 in purchases reported by the telephone and telegraph companies was not general, being confined in the main to states in which there was more than usual activity in the construction of telephone lines during 1910.

Of the total reported purchases in 1911, namely, 3,418,020 poles, 2,402,724 or 70.3 per cent. were made by the telephone and telegraph companies; 787,649 or 23.0 per cent. by the electric railroad, light and power companies, and 227,647 or 6.7 per cent. by the steam railroads.

Leading Varieties of Wood Used.

During the five-year period covered by the report, the total purchase of poles was 17,559,876, of which cedar contributed 11,281,152, or 64.2 per cent.; chestnut, 3,125,403, or 17.8 per cent.; oak, 938,874, or 5.3 per cent.; pine, 798,662, or 4.5 per cent., and cypress, 417,078, or 2.4 per cent. While these five varieties of wood have led in supplying pole material during each of the five years covered, having furnished 16,561,169, or 94.3 per cent. of the total, the tendency which has been noted for several years to substitute less expensive woods for most of them, continued during 1911. With a decrease in the number of poles reported from all woods in 1911 as compared with 1910 of only 11.7 per cent., the loss in cedar was 13.6 per cent.; in oak, 24.8 per cent.; in pine, 12.4 per cent., and in cypress, 3.3 per cent. A slight gain, however, was made by chestnut, of 2.4 per cent. Of the seven other woods separately shown in the subjoined statement nearly all of the poles cut from redwood, tamarack, osage orange, and locust were reported by telephone companies. In all, 35 different species of timber contributed to the total pole purchases in 1911.

Preservative Treatment of Poles.

During 1911 there were 656,504 poles reported as having been given some kind of preservative treatment. This number exceeded the total for 1907 by 260,305, that for 1908 by 312,116, and that for 1909 by 79,873, but was less than the number reported as having been treated in 1910 by 168,169. The principal woods treated in 1911 were cedar, yellow pine and chestnut, while smaller though important percentages are also shown for juniper, oak, cypress, Douglas fir, and western pine.

The Tabular Summary.

The following statement shows by varieties of wood, the number of poles purchased in each year from 1907 to 1911 inclusive:

Kind of Wood.	1911.	1910.	1909.	1908.	1907.
Cedar	2,100,144	2,431,567	2,439,825	2,200,139	2,109,477
Chestnut	693,489	677,517	608,066	516,049	630,282
Oak	199,590	265,290	236,842	160,702	76,450
Pine	161,690	184,677	179,586	116,749	155,960
Cypress	72,995	75,459	77,677	90,579	100,368
Juniper	27,847	20,042	43,581	42,367	38,925
Redwood	26,887	30,421	23,145	13,061	31,469
Douglas fir	24,833	56,732	24,877	19,542	15,919
Tamarack	23,543	30,964	29,889	24,123	13,884
Osage Orange	21,101	23,221	21,491	18,109	5,962
Spruce	10,166	22,929	11,423	8,088	10,646
Locust	8,477	9,030	10,463	10,224	4,672
All other	47,258	42,845	31,875	29,422	89,254
Total	3,418,020	3,870,694	3,738,740	3,249,154	3,283,268